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ELECTRIFICATION STUDIES AT BOSTON.

Among the larger transportation questions which are under consideration by the Massachusetts commissions this fall, the problem of steam-railroad electrification within the Boston metropolitan district occupies a most prominent place. The reports filed by the steam railroads will be found in abstract on page 1110 of this issue. As might have been expected, the New York, New Haven & Hartford Railroad and its affiliated lines adhere to the single-phase system as furnishing the most promising solution of the problem; while the Boston & Albany, a leased property of the New York Central company, has been studied on the basis of direct-current, third-rail distribution, the most striking feature being the proposed use of a 1,200-volt service at the locomotives and multiple-unit trains which are planned for the through and local traffic requirements.

These studies are interesting on account of the wealth of technical detail with which the investigations have been set forth, and by means of which a final estimated cost of nearly $40,000,000 is reached. The problem for the New Haven interests is much more complex than for the Boston & Albany, since it involves the electrification of over a score of radial lines with many branches compared with a relatively simple two and four-track electrification on the latter road. If carried out the Boston & Albany electrification will probably extend westward to South Framingham, twenty-one miles from Boston; that of the New Haven would be carried at least to the distance of Brockton and logically to Providence; and that of the Boston & Maine would presumably be carried to the limit of an engine stage on the more important trunk lines. For the metropolitan service alone it is estimated that a power-generating capacity of at least 60,000 kilowatts would be needed by the Boston & Maine and the New Haven lines; while if the Boston & Albany electrification were carried to Worcester, forty-four miles from Boston, about 15,000 kilowatts would be required.

Apart from the technical details of the studies which are of special interest to railway engineers, it is noteworthy that the railroads are at present decidedly opposed to electrification on the ground of its first cost, and in a measure, because of its operating expense. The Boston & Albany gives warning that if the public insists on electrification at the present time—and the prospects are decidedly in favor

of the passage of a bill with this intent in the 1911 Legislature—fares will have to be raised in order to maintain the solvency of the road. The New Haven company declares that under present conditions its electric train service not only fails to earn any interest on the very large amount of capital invested, but that it has also increased the cost of operation, and with the less favorable conditions in the vicinity of Boston, it is impossible to escape the conclusion that the deficit in fixed charges and operating expenses will be still greater. These utterances are natural enough, but it is worth noting that electrification is still in its infancy so far as its commercial results can be measured, and that its final economies and traffic-stimulating capacity can be gauged only when an entire engine stage has been completely equipped and operated by electricity in the handling of every phase of its passenger, freight, express, mail and company service for a period sufficiently long for accurate figures to be assembled and compared with other figures including both the old and the new conditions of operation. On broad grounds the growth of metropolitan Boston and the increase in population of suburban areas, at present provided with frequent but not fast trolley service, is certain to be greatly stimulated by electrification. The entire Newton and Brookline district, for example, is susceptible of an expansion comparable in many respects to that now in progress in the West Roxbury district of Boston, as a result of the opening of the Forest Hills extension of the Boston Elevated Railway Company. With the entering wedge driven at New York it is logically certain that the populations of the larger cities of this country will demand a taste of the same thing. If it proves to be a luxury, the public have to meet the expense, but that electrification is coming, no one familiar with the tendencies of the transportation industry can reasonably doubt.

MUNICIPAL PROVISION FOR MANUFACTURING FACILITIES.

When in the expansion of an industry the individual manufacturer or manufacturing corporation finds it expedient to largely increase facilities for production, it is realized that the attitude of the municipality with respect to certain privileges can mightily affect this process of expansion. Very often a large manufacturing interest, which has grown up within the confines of a certain community, finds itself hampered in its extensions either through the indifference or hesitancy of the officers making up the municipal governing body. Too often there is a feeling upon the part of the municipality that the manufacturing interest is getting privileges which outweigh the good that they do for the community, and more often the value of the industry to the community is not even given serious consideration. This is less the case with new communities than it is where there may be located a number of substantial manufacturing interests.

A case in point was strikingly brought to view in an address which was made before a notable gathering at a banquet of the Press Club of Schenectady, N. Y., when G. E. Emmons, of the General Electric Company, analyzed this matter and indicated several ways in which the city could greatly facilitate the extensions which this great manufacturing enterprise might find desirable. Situated close to the railroad, but still far enough away from the main street to be practically isolated, there is urgent need of the widening of the avenue of approach. The thousands of employees who reside in various parts of the city make it desirable that superior transportation facilities be acquired. The street-railway company is ready to increase its service, but the municipality is haggling over a franchise requisite. Schenectady has competition, and the General Electric Company in a recent extension has found it expedient to begin the construction of a large plant at Erie, Pa., where every inducement is being held out by the local authorities to render this development easy of justification.

Schenectady is not alone in this predicament. There are numerous other cities in which a similar condition prevails, and it will be well for the municipal authorities to look into the great benefits conferred upon any community when a large manufacturing interest, or a large operating company, builds up a profitable enterprise, and see that what the city has secured may be retained, and to see that any extensions and improvements which may be contemplated are accorded liberal treatment. And in the end such an attitude on the part of the authorities will redound to the greater benefit of the community and will prove one of the strongest factors in influencing the establishment of other manufacturing interests.

LAMP EFFICIENCY AND TEMPERATURE.

A simple method of demonstrating that the higher efficiency of the metal-filament lamp is due to selective radiation was given by Mr. Hartwig von Loeti in an address recently delivered in Vienna before the local society of electrical engineers. Carbon and metal filaments of the same dimensions were secured and were operated at the same efficiency. To do this it was necessary to supply about three times as much power to the carbon filament as to the metal filament, and therefore to produce about three times the light. Consequently the surface per candlepower was much less (one-third) for the carbon, when operating at the same efficiency. This means, of course, that it was at a higher temperature. If the metal-filament lamp gives the same efficiency at a lower temperature, it must be because it emits selectively.

A body devoid of selective emission—the so-called "black body"—has its radiant energy distributed throughout the spectrum, visible and invisible, according to Planck's law. The wave-length for which the energy is a maximum is in the infra-red, but approaches the visible

spectrum as the temperature is increased. For such bodies, it necessarily follows that the proportion of the energy within the limits of visibility, that is the luminous efficiency, increases with the temperature. For selective bodies, however, the energy radiated in different parts of the spectrum is less than for a black body—and less in different proportions for various wave-lengths. If the radiation of invisible wave-lengths is a smaller proportion than the radiation of visible wave lengths, the luminous efficiency will be greater at the same temperature, or may reach the same value at a lower temperature. It appears that carbon approaches more nearly to the theoretical "black body" than most metals. That tungsten and other metals available for lamp filaments radiate a larger proportion of energy in the visible spectrum has been already shown by other investigations, such as those of Dr. W. W. Coblentz, mentioned in our issue of September 10, 1910.

OUTLINE LIGHTING.

One branch of exterior illumination that has not received the attention that it merits is the lighting of the facades of our important buildings. It is only during great fêtes, such as the Hudson-Fulton celebration last year, that any extensive displays of this kind have been made. But even on such occasions little has been attempted beyond stringing a few rows of low-candlepower carbon-filament lamps along what were assumed to be some of the principal lines of the buildings. The term outline lighting originated from this practice.

While outline lighting has usually been regarded favorably by the general public, it has been quite often severely criticised by architects because in many instances the important architectural lines of the building were entirely ignored and the light from the few rows of lamps in use was so dim as to leave the body of the structure in gloom, thus producing a sort of spectral effect. To overcome these objections it was evidently desirable to use the lamps liberally, to use whiter and brighter lamps, and to place them so as to enhance the architectural effect and at the same time so that their radiance would be cast over the entire face of the building. To carry out a plan on these lines means, of course, the expenditure of considerable money for equipment and operation, but that it is commercially feasible is shown by the very excellent illumination of the new building of the Denver Gas & Electric Company, which is described and illustrated on other pages of this issue.

The Denver Company has been a leader in many successful commercial methods that have been adopted by wide-awake central stations. In the lighting of its new building it has established a new record of achievement by a public service company. This lighting not only meets the architectural requirements enumerated above, but is bound to arouse enthusiasm for its artistic beauty. It is the finest example of facade lighting ever attempted.

DOES COLLEGE RESEARCH PAY?

In most of our engineering schools and colleges a thesis, based on an original research, is required for a technical degree, especially in the master's or doctor's grade. And the question naturally arises, "Does it pay?"

Looking casually over the work that has been accomplished by scientific research, it must be admitted that much that has been of value has been achieved in the most haphazard way, in many cases even as the result of accident. Men have groped in the dark after one thing, and much to their surprise have often discovered an entirely different thing, quite by chance, but sometimes of vastly more importance than the object in mind. Thus, for example, Bell endeavored to improve the hearing of the deaf and was lead to develop the telephone, an invention which even the wisest of scientists at the time did not dream would so completely revolutionize our methods of communication. Again, much important research work has been accomplished only after the expenditure of much time and money by specialists, men of distinction in their own line, working in well equipped laboratories maintained by enterprising manufacturing companies. College professors, too, have contributed largely to modern industrial progress by discoveries made in their laboratories. But the individual student working for a degree, what has he done in the line of research, either before graduation or afterward?

An answer to this last question is contained in an inquiry recently made regarding the success in after life of the Doctors of Science graduated from one of the foremost of the English universities. In this institution the degree of Doctor of Science may be obtained either by a stiff examination or by research.

The inquiry showed that more success was attained by those students of this British university who obtained their Doctor's degree by examination and not by the presentation of an accepted thesis on an original research.

One deduction from this would seem to be that in a college course the best results would accrue by taking a general line of study, leaving specialization to be taken up in practical work in after life.

All English professors do not concur in this. At the recent opening exercises at the new engineering laboratories of the University of Liverpool, Professor Watkinson showed that as a result of research in college laboratories the Germans were far ahead of England in the invention and design of internal-combustion engines. But it may be said, it was England with her so-called untrained engineers that produced the actual Dreadnaught. And, in fact, many of the epoch-making discoveries have been made by practical men and not by scientists. The scientist has his place in mechanical evolution, but too much emphasis must not be placed on theoretical superspecialization in our learned institutions. What is required is a sound foundation for future practical evolution.

Fixation of Atmospheric Nitrogen.

Several papers describing work carried on at the Institute of Technology in Karlsruhe, by Professor Haber and his associates, were published in a recent issue of the *Zeitschrift für Elektrochemie*. One series of experiments made with direct current was for determining the maximum concentration at reduced pressures. The arc was produced in a fused-quartz tube which was externally cooled with water. The curve of concentration showed a decided maximum at a pressure of 150 millimeters of mercury when 8.16 per cent of NO resulted. Fourteen hundred volts were used and the current was 0.27 ampere. With pressure greater than the atmospheric no improvement in the yield was obtained.

In another experiment the arc was produced in narrow metallic tubes cooled from the outside, through which the air was pumped at high speed. Direct current was used at from 3,000 to 6,000 volts. A concentration of 2.5 per cent NO resulted and a yield of eighty grams HNO_3 per kilowatt-hour was obtained.

In another set of experiments high-frequency alternating discharges were used. The frequency had little influence on the yield so long as a large amount of energy was used, and the arc extended by blowing it out. If these precautions are not taken the yield is lower.

The usual yield, commercially, is from fifty to seventy-five grams of HNO_3 per kilowatt-hour, providing preheated air is used. If the air is not preheated the yield is about fifty grams per kilowatt-hour.

Heroult Process in America.

A number of changes are to be made in the near future in the plants of the United States Steel Corporation, which has secured the sole rights for the use of the Heroult patents for electrical steel making and refining. Enough changes involving the installation of the Heroult furnaces have been made to warrant the estimate of 125,000 tons of electrically refined steel for the coming year.

Endowment for Carnegie Schools.

Andrew Carnegie celebrated his seventy-fifth birthday recently by making a gift of $3,500,000 to the Carnegie Technology Schools in Pittsburg. Of this amount $1,500,000 will be put at once into buildings and equipment and $2,000,000 will be forthcoming as endowment.

Chicago Electrical Show.

There is every reason to believe that the sixth annual exhibition of the Chicago Electrical Trades Exposition Company, which occurs in the Coliseum from January 7 to January 21, will surpass all former electrical shows not only as to the number of exhibitors but also in the beauty and novelty of the decorative scheme, which has always been a big factor in making these annual expositions attractive to the public.

An entirely new scheme of decoration has been created by D. H. Burnham & Company, the architects. Their former ideas along these lines have been extremely successful, and it is safe to predict that the plans for the 1911 show will be startling for their beauty, individuality and exclusiveness.

The fact that the management is this year sharing a large percentage of the profits with the exhibitors, pro rata, is a source of much satisfaction to the trade, which is responding more quickly and more liberally in the matter of contracting for space. Up to this writing more than sixty per cent of the available floor space has been sold, the list of exhibitors representing the entire field of the electrical science and industry.

One gratifying feature noticeable in the early list of exhibitors is the unusually large number of concerns whose names appear in connection with that exhibition for the first time.

Bed-Spring for Antenna.

Willard E. Brown, of Medford, Mass., has found it possible to receive wireless messages by connecting his receiving apparatus to the corners of his bed-spring in an attic chamber. It is not necessary to disturb the bed in any way. The usual ground connection is made through the water pipe.

Wireless on Cargo Steamers.

The cargo liner *Drumcraig*, owned by Joseph Chadwick & Son, of Liverpool, has been equipped with a wireless-telegraph outfit furnished by the British Radio Telegraph Company. This is the second British cargo liner to be so equipped, the other being the *Nonesuch*, which was furnished with a wireless set by the same company some time ago.

Meeting of New England Section, National Electric Light Association.

The New England Section of the National Electric Light Association will hold its annual meeting and convention at the American House in Boston, Mass., Wednesday and Thursday, March 15 and 16, 1911.

The Executive Committee has decided upon a programme of three papers and a report from the very important Committee on Rates. The subjects of the papers are: "Development and Application of Electricity to Domestic Purposes," "Rotary Condensers," and "The National Electric Light Association System of Accounting as Applied to Small Plants."

A paper will be read at each of the three sessions, Wednesday afternoon, Thursday morning and Thursday afternoon, and probably the report of the Committee on Rates will follow the banquet Thursday evening.

The first annual convention of the New England Section, which was held last March at the American House, was generally voted the most successful, profitable and inspiring meeting of electrical interests ever held in New England. Nearly five hundred members and guests were present and many additions were made to the membership. It is anticipated that the next convention will be even better in all points, as one of the mottoes of the New England Section is, "Steady Improvement of the Load-Factor."

International Exposition of Aeronautics and Aviation.

During the next two months, December, 1910, and January, 1911, there will be held in the Crystal Palace at London an international exposition of aeronautics and aviation. It is intended to cover all branches of aerial locomotion, there being sixteen divisions planned for the exhibition. The principal divisions will, of course, be those for free balloons, dirigible balloons and aeroplanes. The historical development of aeronautics will also be shown by many exhibits.

Edison's Home Damaged by Storm.

Thomas A. Edison's winter home at Fort Myer, Fla., was considerably damaged by the hurricane which recently swept over the Gulf of Mexico. Part of his pier was torn away, and a number of his boats were destroyed.

John Stone Stone.

There have been so many practical applications of the science and art of wireless telegraphy within recent years that a great deal of the wonder attendant upon the demonstrations of this highly mysterious phenomenon has given way to a commonplace acceptance of the thing as an ordinary part of everyday activity. Without doubt the advance which its application has made within the past decade has been due to the remarkable activity and genius of just a few investigators. Among these investigators one of the most prominent figures is the subject of this sketch, John Stone Stone.

JOHN STONE STONE.
Prominent Wireless Inventor, Expert and Writer.

Mr. Stone was born in Dover, Goochland County, Va., September 26, 1869. His father, Charles Pomroy Stone, was born in Greenfield, Mass., September 30, 1824. The elder Stone was a soldier and engineer, a graduate of the United States Military Academy, a veteran of the war with Mexico and the Civil War, and a lieutenant-general in the Army of Egypt, chief of general staff and general aid-de-camp to the Khedive of Egypt, besides holding a number of other offices in the military and engineering departments of Egypt.

John Stone Stone early in life was an apt student of physics and chemistry. His childhood was passed largely in Egypt and Europe, and upon the return of his parents to the United States in 1883, he studied at Columbia Grammar School in New York City for two years, for two years at the School of Mines of Columbia University, and for two years at Johns Hopkins University, Baltimore, Md. In 1890 he entered the laboratory of the American Bell Telephone Company at Boston, remained in the employ of that company first as an experimentalist, and after as expert until in 1899, thereafter being retained for several years as expert. He was a professional consulting electrical engineer on his own account from 1899 to 1902, when he became chief engineer of the Stone Telegraph and Telephone Company. He was also special lecturer on electrical oscillations and other applications at the Massachusetts Institute of Technology for a number of years. He has secured more than one hundred United States patents and a corresponding number in foreign countries covering various inventions, including a system for centralizing the energy in telephone systems in 1893, which came into very general use in the United States and abroad. In 1897 a patent was granted to him for an operative method for increasing the efficiency of telephone lines by the increase of the inductance of the line. His method, however, was superseded by one patented by Prof. M. I. Pupin, of Columbia University, New York. In 1902 and 1903 he took out a group of patents covering a system of selective wireless telegraphy free from interruption, and in 1903 patents covering the first application of electrical resonance to useful arts. He has also been granted patents for a system of wireless telegraphy in which the messages are automatically rendered secret or illegible except at the station at which they are intended to be received, for a system by which ships at sea may determine their bearings by wireless telegraph communication with shore stations, and also for a system of wireless telephony now in very general use.

He was a member of the International Electrical Congress which met at St. Louis in 1904, at which he read a paper entitled "The Theory of Wireless Telegraphy." This paper has been considered to be the most masterly and comprehensive mathematical analysis ever written upon this subject.

He is a fellow of the American Association for the Advancement of Science, past president and present vice-president of the Society of Wireless Telegraph Engineers, member of the American Electrochemical Society, associate of the American Institute of Electrical Engineers, associate of the United States Naval Institute, member of the Society of Arts of the Massachusetts Institute of Technology, vice-president of the Wireless Telegraph Association of America, member of the Mathematical and Physical Club, of the Alpha Delta Phi Fraternity, the Johns Hopkins Alumni Association of Massachusetts, and of the Club of 1847.

His social clubs are the St. Botolph, Technology and Papyrus Clubs of Boston, the National Arts Club of New York, the Cosmos Club, and the Army and Navy Club of Washington, D. C. He has been a prolific contributor to the scientific press and has presented a number of valuable papers before the engineering societies of the United States.

The magnetic survey yacht *Carnegie* left Para, at the mouth of the Amazon, on October 15, bound for Rio de Janeiro. This vessel, since leaving Brooklyn last June on her present cruise of three years in the Atlantic, Indian and Pacific Oceans, has covered nearly 7,000 miles up to Para. From Rio de Janeiro the *Carnegie* will proceed to Montevideo and Buenos Aires, and thence across to Cape Town.

Lectures for Operating Engineers.

A lecture course is to be given under the auspices of the Modern Science Club of Brooklyn, N. Y., beginning December 2, by A. R. Maujer, entitled "Lecture Course for Operating Engineers." The lectures will cover the following subjects: Principles of Combustion; Draft; Flue-Gas Analysis; Evaporation; Boiler Design; Boiler Rating and Efficiency; Scale and Scale Treatment; Steam-Engine Indicator; Planimeter; Steam-Engine Calculations; Single, Double and Triple-Expansion Engines; Condensers; Cooling Towers, etc.

The Club will give a smoker at its rooms, 125 South Elliott Place, on the evening of November 26, at which full announcements of the lectures will be given.

Electric Mining in Mexico.

In the enlargement of its machinery equipment the Negociacion Minera de San Rafael y Anexas, of Pachuca, Mexico, has provided for a motor installation totaling 2,000 horsepower, the larger motors taking power direct from the main circuit at 2,000 volts, and the smaller motors at 440 volts from several groups of transformers. Motor-driven pumps are used in the cyanide plant for handling slimes, sands and solutions, each tube mill is operated by a 100-horsepower motor, while in the stamp mill a 75-horsepower motor is employed to drive each group of twenty stamps.

Railroads of New England Favor Telephone Method.

Railroads operating through New England have been among the leaders in the movement to replace the use of the telegraph with the telephone for the work of dispatching trains. The new method has been found satisfactory on a great many trunk lines of the country, and has many advantages in the way of accuracy, speed and safety.

The New York, New Haven and Hartford Railroad already has in operation telephone circuits covering 100 miles of its road from Northampton to New Haven, with branches to Holyoke and New Hartford. There are twenty-nine telephone stations on this division, which is equipped with test panels, selectors and flexiphones.

Sixty-eight stations are in operation on the Boston & Maine Railroad, covering the White Mountain Division and the Concord Division. These circuits extend from Concord to Woodside, ninety-three miles, White River Junction to Concord, seventy miles, and Boston to Fitchburg, fifty miles. The best grade of copper wire is being used, together with telephone arms, selectors, wrecking outfits and portable sets.

The Central Vermont Railroad has just ordered telephone equipment to cover its northern division from St. Albans to Windsor. On this stretch of 150 miles there will be thirty-eight telephone stations, which will be equipped with telephone arms and circular loom cable.

The Boston & Albany Railroad already has in successful operation telephone equipment covering the whole of its main line and all branches from Boston to Albany. On these four circuits, extending 390 miles, there are 165 stations.

Exhibition of Motor Drive.

The Birmingham (England) Electric Supply Department held an exhibition of its electric-motor drive from November 1 to 15 last. Working models of electrically driven rolling mills, shearing machines, welding machines, spindle drills, emery grinders, blowers, etc., were shown. A large number of manufacturers witnessed the daily demonstrations.

Convention of Electrical Jobbers.

The Electrical Jobbers' Association held its winter convention at Hot Springs, Va., on November 9, 10 and 11, when several papers were discussed and a general good time indulged in. In line with its usual spirit of fraternity, a song composed by W. H. Sheldon, Jr., was rendered as a surprise and tribute to W. W. Low, president of the Electric Appliance Company, of Chicago, and one of the most influential and progressive members of the jobbers' association. Mrs. George S. Searing was presented with a silver mesh bag in recognition of the esteem in which Mr. Searing ("Uncle George") is held. There was a fine entertainment program, and the sports included clay-pigeon shooting, W. C. Hopkins, first prize; pool and billiards, J. A. Vaughan and F. E. Stowe; and golf, with H. V. Carter, R. B. Corey, F. Oblinger, M. B. Austin and A. Palmer as prize winners.

Central Electric Railway Association.

The regular bi-monthly meeting of the Central Electric Railway Association will be held at the Phillips House, Dayton, O., on December 1. The following papers will be read: "Recent Developments in Car Heating," H. S. Williams; "Traffic," W. O. Woodard; "Gears and Pinions," T. W. Williams; "Wood Preservation," A. L. Kuehn.

English Railroad to Electrify.

It is stated, says *Electrical Engineering* (London), that the Great Eastern Railway Company has secured a site at Enfield, England, for the purpose of erecting a power house in connection with the contemplated conversion of some of its suburban to electric traction.

Single-Phase Equipment for Hoosac Tunnel.

The New York, New Haven & Hartford Railroad is to use single-phase equipment in the Hoosac tunnel in spite of the fact that its present single-phase installations are criticized to a certain extent. Power will be supplied at 11,000 volts.

Philadelphia Electrical Assets.

The city of Philadelphia is, on the initiative of the city controller, making an inventory of all the municipal departments. James E. McLaughlin, chief of the Electrical Bureau, has turned in a report showing the equipment of that bureau to be valued at $2,997,000.

Metropolitan Street Railway Sale.

The foreclosure sale of the Metropolitan Street Railway Company, scheduled for November 14, was postponed until January 5. On this date the property pledged under the $12,500,000 first-mortgage bonds will be sold at noon and the property under the $16,604,000 refunding four-per-cent bonds will be sold at 2:30 p. m.

Examination for Aid, Bureau of Standards.

The United States Civil Service Commission announces that on January 4 and 5, an examination will be held at the usual place for eligibles to fill vacancies in the position of aid, Bureau of Standards, Washington, D. C.

Those interested should make application for Form 1312.

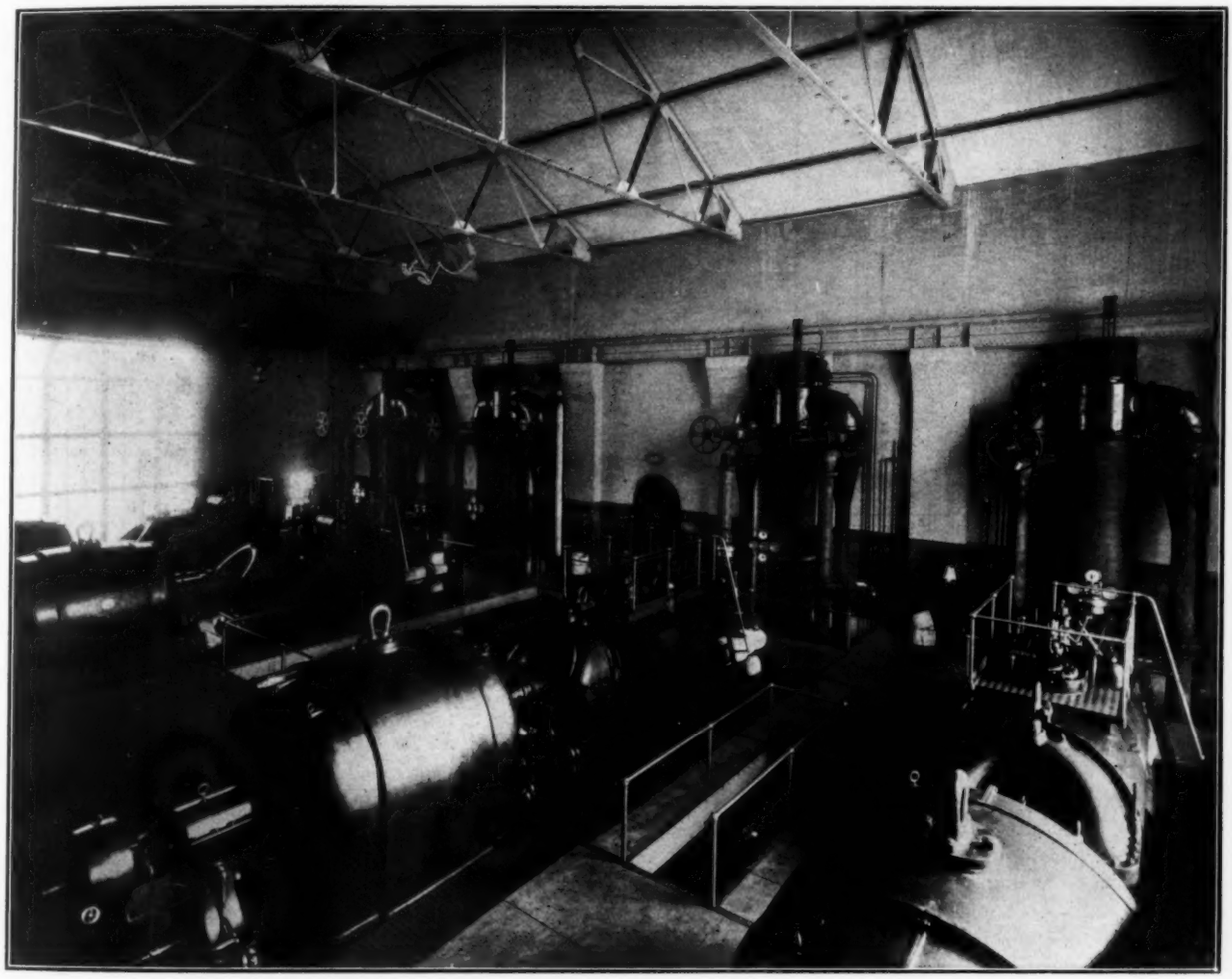
United States Capitol and Congressional Buildings.

Heating, Lighting and Power Plant for the Government Buildings at Washington.

During the past few weeks the heating service of the heating, lighting and power plant of the United States Capitol and Congressional Buildings at Washington, D. C., was inaugurated and the most complete power plant of its character in the country officially turned over to the Government as complete.

There have recently been completed at Washington two handsome buildings, known as the Office Building of the Senate and Office Building of the House of Representatives, and when it was decided to erect a central power plant to furnish light, heat and power for these two buildings, plans were made for making the plant of sufficient capacity for supplying the United States Capitol, the Congressional Library and a proposed new structure which is to house the Supreme Court of the United States.

This entire aggregation of buildings is embraced in an area of not more than four acres and is approximately 3,500 feet from the central power station, which is located on a government reservation, known as Garfield Park, just south of the Capitol grounds.



TURBO-GENERATORS IN CENTRAL POWER STATION, GARFIELD PARK, WASHINGTON, D. C.

The lighting, heating and power plant of the United States Capitol and Congressional Buildings is a handsome three-story modern steel-frame structure built of red brick and cement after the old mission style. Reinforced concrete has been used throughout for all supports, floors and roofing, and the entire structure rests on a concrete pile foundation. The building is shaped like the letter T, the vertical stem, running north and south, being the boiler-room section, and the top of the T the turbine-room section.

Coal is brought to the plant in cars on a spur track running adjacent to the south wall. A standard track scale is installed directly over a crusher pit, and after being weighed the coal is dumped into a motor-driven crusher. It is then conveyed, by means of belt conveyors, to the bucket conveyors, which raise the coal to the third floor of the building and here discharged into the coal bunkers. Chutes connect these bunkers with the stokers.

The boiler room of the plant is 86 feet by 160 feet and is fourteen feet above the street level. The equipment includes sixteen water-tube boilers of Atlas make, located in two rows of

eight. A view of the boiler room is shown herewith. Each boiler is rated at 600 horsepower and has an evaporating capacity of 21,000 pounds of water per hour, at 212 degrees Fahrenheit, at 175 pounds gauge pressure. Each boiler is equipped with a Rooney mechanical stoker. These stokers are operated by Westinghouse standard steam engines, one engine being used to operate four stokers. The engines are so arranged that any engine can be connected so as to operate any battery of four stokers on one side of the boiler room.

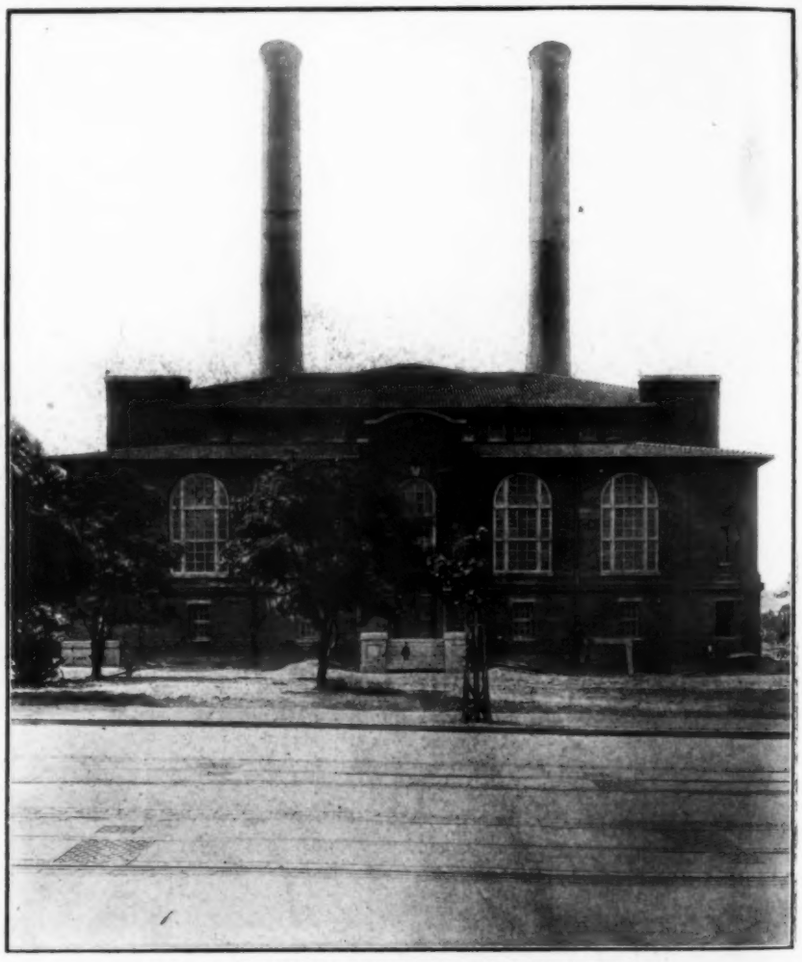
A complete ash-handling system has been installed, which makes for ease of operation and cleanliness. Ashes are automatically dropped into ash hoppers under each boiler, and these in

STEAM-PIPE TUNNEL.

turn dropped into hand dump cars run on tracks in the basement. The hand cars are then rolled to an ash pit, at the south end of the plant, and from there are conveyed by means of ash skips to the top of the building and dumped into chutes suspended over railroad cars to be hauled away. There are two ash skips, each operated by a fifteen-horsepower motor, one for each row of eight boilers.

In view of the importance of the plant it has been the aim of the engineers to supply the buildings at all times with uninterrupted service and in furtherance of this all machinery and apparatus, whenever possible, has been installed in duplicate. This is particularly true as regards piping, a complete duplicate system having been installed.

The main fourteen-inch header runs directly under the boiler-room floor between the two rows of boilers. Ten-inch lines are run from each boiler to the main header. These lines are arranged in groups of four, and any group may be cut out or tied to any other without affecting the service. Each group is also connected to the next group by a ten-inch loop. From the main header a fourteen-inch line is also run to the heating mains, which run in tunnels to the various buildings. The piping is all of heavy wrought iron with welded flanges.



THE CONGRESSIONAL LIGHTING AND HEATING PLANT.

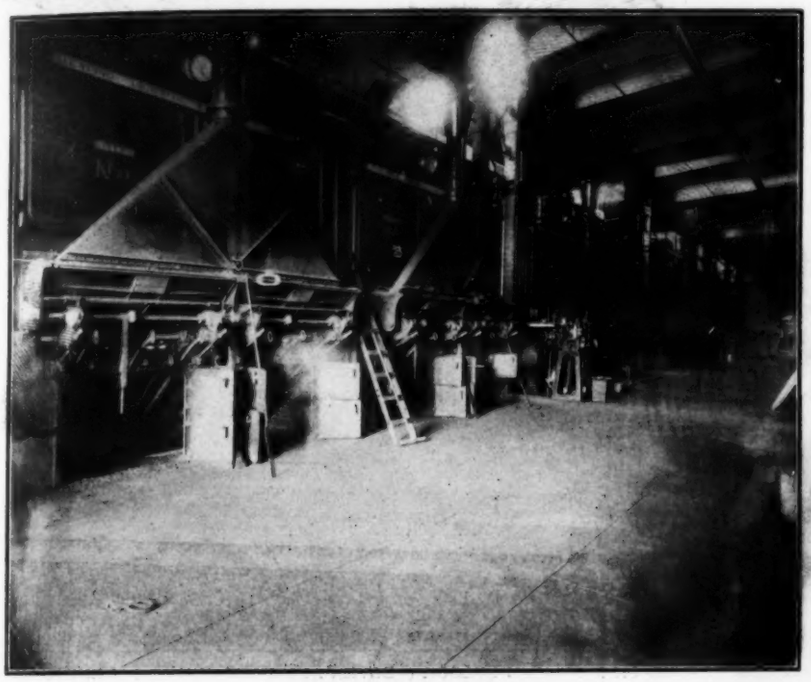
At the junction of the engine and boiler room are installed four Buckley twin barometric injector condensers, comprising two sets of two condensers each, and these are connected by a forty-two-inch cross and provided with a twenty-four-inch inclosed automatic exhaust relief valve having hydraulic lifting cylinders.

Directly north of the condensers, in the basement of the plant, are installed the three boiler-feed pumps, which are connected to the hot well and city mains. These pumps are of the balanced piston type and each is of sufficient capacity to supply one-half of the plant.

The plant is equipped with Metropolitan injectors with Hancock swing check valves, which are held in reserve should the boiler-feed pumps fail to operate or if the load is such that they would be more economical to operate than the pumps.

Not depending on the city mains for its water supply, the plant receives water through a thirty-six-inch main from its own pumping station located on the eastern branch of the Potomac River. This station, which is situated about 4,300 feet from the central power plant, is provided with two eighteen-inch vertical centrifugal circulating pumps each direct connected to a 250-horsepower vertical induction motor. Each pump has twenty-inch water openings and is capable of supplying 150

gallons per minute and maintaining a head equal to fifty pounds pressure per square inch. The motors driving these pumps may either be started at the pumping station or directly from the switchboard in the power plant.



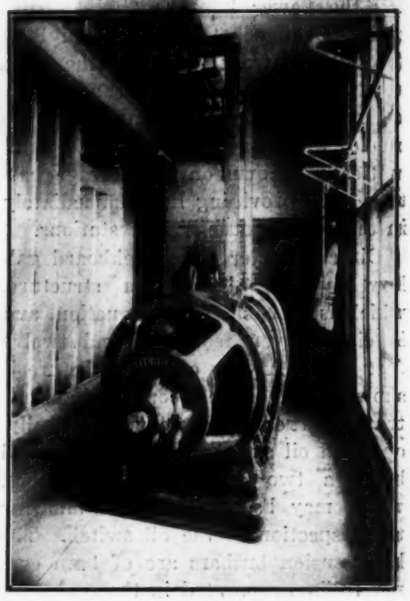
THE BOILER ROOM.

Among the characteristic features of the Congressional lighting and heating plant are the two ornamental stacks.

BOILER-FEED PUMPS.

Water from the hot well is taken by gravity through a forty-eight inch concrete overflow flume to the river. This flume runs parallel to the thirty-six-inch main supplying the condensers. They are each 250 feet in height by eighteen feet in diameter at the base and eleven feet at the top. The stacks each have a red brick octagon-shaped base forty-eight feet in height, and above this they are cylindrical in shape and are built of buff-colored chimney brick. The usual inside and outside ladders are provided and each chimney is surmounted with a twelve-section iron cap.

The turbine section of the plant is 83 feet by 116 feet and the apparatus and machinery is so arranged that the room presents a very pleasing appearance. The basement of the turbine section is occupied by a storage battery and the boiler-feed pumps, and on the mezzanine floor running the entire length of the north wall is the switchboard gallery and the visitors' gallery.



BOOSTER SET.

The generating equipment consists of four 2,700-horsepower Westinghouse-Parsons turbines direct connected to four 2,000-kilowatt, 6,600-volt Westinghouse, three-phase turbo-generators. The machines run at a speed of 1,500 revolutions per minute. The turbines are equipped with an equalizing stop valve placed in the steam line and operated from a separate safety governor, which automatically closes the valve when the turbine speed exceeds the safe limit. There are four 37.5-kilowatt exciters, one mounted on each generator shaft.

The switchboard is located at the center of the mezzanine floor in such a position that the operator may have the entire plant in full view. It is constructed of white Italian marble and is

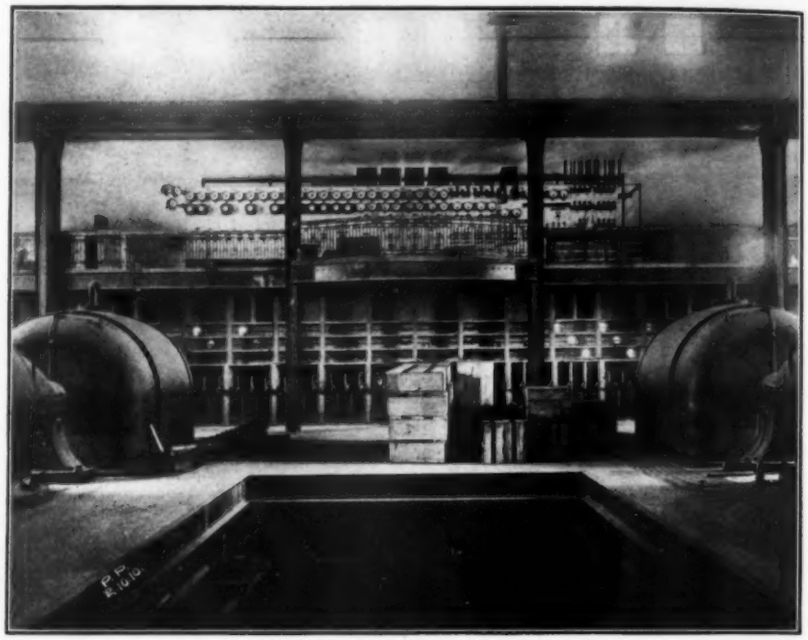
composed of nineteen panels, comprising four generator panels; five feeder panels, controlling the feeders to the various substations; two storage battery panels; two exciter panels; one panel for the booster set; one for the pump motors; one for the station lighting and three for the station power service and substation lighting. The board is equipped with all of the latest measuring and regulating instruments, by means of which a careful check can be kept on all operations.

The wiring of the switchboard is all in duplicate. There are two sets of busbars, duplicate feeders, duplicate busbars for the storage battery, etc. There is an emergency panel for lighting the power house and all substations. Ordinarily these are lighted through the transformers in the basement, but it has been so arranged that in case the alternating current is cut off for any cause, this circuit is automatically thrown on the storage battery, thus providing light immediately in the power house and substations.

Directly under the switchboard gallery is the high-tension structure, which is of concrete construction, and is eighty-seven feet long and twelve feet high. A view of this structure is shown in one of the accompanying illustrations. It contains twenty electrically-operated oil switches, which are placed between two disconnecting switches, which may be cut off, thus allowing the inspection of the oil switch. The high-tension busbars are of bare copper tubing, separated in the center by sectionalizing knife switches, thus enabling the system to be divided into two parts and operated separately. The high-tension structure also contains the transformers for the instrument circuits.

In the basement of the turbine section, on the east side, there is installed a seventy-four-cell "Chloride Accumulator," furnished by the Electric Storage Battery Company, Philadelphia, Pa., which is used in connection with the exciter system and also for the operation of the fifty-ton Shaw electric crane which spans the turbine room. The storage battery is also used for the emergency lighting of the plant and substations in case of a breakdown in the alternating-current system. It has a normal discharge rate of 200 amperes and of 800 amperes for one hour.

For charging the storage battery there is installed in the plant, directly north of the high-tension structure, a booster set consisting of a fifty-seven-horsepower motor direct connected to a forty-four-kilowatt booster generator having a capacity of 845 amperes at sixty-five volts.



SWITCHBOARD ON MEZZANINE FLOOR (ABOVE), AND HIGH-TENSION STRUCTURE (BELOW).

THE HIGH-TENSION STRUCTURE.

In a room in the north end of the basement there are installed two sets of transformers, each set consisting of three 125-kilowatt, single-phase, twenty-five-cycle, oil-cooled transformers, for lighting the plant and furnishing power for the auxiliary apparatus. These transformers are Y-connected on the four-wire system and step down from 6,600 volts to 200 volts for power and to 125 volts for lighting circuits.

For transmitting steam to the various buildings an elaborate system of

tunnels has been constructed. They are of reinforced concrete construction and have an aggregate length of about 6,000 feet. The tunnels are seven feet high by four and one-half feet wide and are provided with suitable entrance manholes at various points of convenience. The tunnels are provided with electric light and are so wired that an operator can turn on or off any series of lamps before and behind him as he goes.

Steam is conveyed through wrought-steel piping with welded flanges. High-pressure steam is sent through this piping and reduced in pressure on reaching each of the buildings. From the plant to the point where the tunnel branches off to the various buildings a fourteen-inch pipe is used, from which point it diminishes in diameter to twelve inches and ten inches.

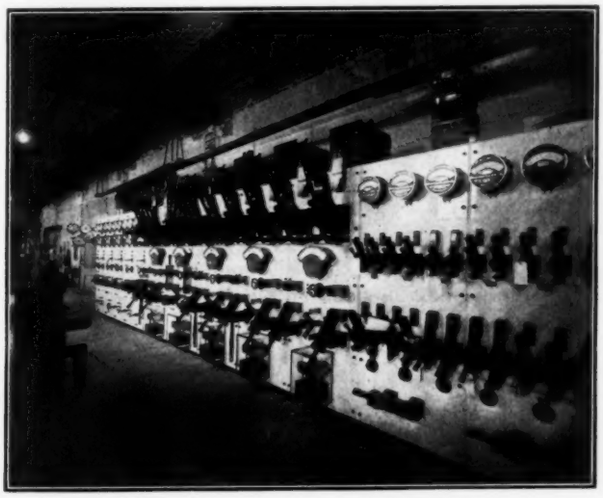
Electric current is transmitted through three-conductor cables laid in vitrified conduit running parallel to the heating tunnels. All wires in the station and substations are run in iron conduit.

At present current is supplied to four substations, located at the United States Capitol, Congressional Library, Office Building of the Senate and Office Building of the House of Representatives. A view of the substation at the Capitol is shown herewith as being typical.

Current is received at the substations at 6,600 volts and changed to direct current at 125 volts by means of motor-generator sets. These sets consist of a synchronous motor direct connected to a 400-kilowatt, 125-volt, direct-current generator. There are five such sets at the Capitol, three at the Library, four at the House Office Building and three at the Senate Office Building.

The Government supervision of the plant comes under Elliot Woods, superintendent of the United States Capitol Building and grounds. C. C. Sharah is chief engineer of the plant.

MOTOR-GENERATORS IN CAPITOL SUBSTATION.



SWITCHBOARD IN CAPITOL SUBSTATION.

Harmonizing Patent Laws.

The International Congress for the Protection of Industrial Property has been invited by the President of the United States to hold its next meeting at Washington, D. C., on May 21, 1911. The date was originally set for May, 1910, but was postponed one year to give time for the thirty-five nations participating to prepare material to be considered. The Congress will be composed of able and experienced delegates, most of them officials of the nations they represent. They will discuss and act upon measures to bring about international concessions and agreements in patent and trademark laws, with the object of harmonizing the laws of the various countries. At present the patent laws of different nations are so widely at variance as to cause great inconvenience to inventors and manufacturers.

Sad State of Gas Meters.

The annual report of the inspector of gas and meters of the District of Columbia has been published. It covers the fiscal year ended June 30, 1910. Interesting in this report is the disclosure of the sad state of many of the meters used in the city of Washington.

Requests for meter inspections were received from 955 consumers supplied by the Washington Gas Light Company. A careful inspection of these meters showed that 333, or 34.87 per cent, were registering fast, average error 5.22 per cent; 63, or 6.60 per cent, were slow, average error 6.10 per cent; 558, or 58.43 per cent, complied with the legal requirements; and one failed to register.

Of 743 registers inspected on complaint of the Company, 8, or 1.08 per cent, were fast, average error 5.26 per cent; 382, or 51.41 per cent, were slow, average error 25.75 per cent; 19, or 2.56 per cent, complied with the law, and 334, or 44.95 per cent, failed to register the gas passing through them.

Wireless Telegraphy in East Africa.

Consul A. W. Wendell, Zanzibar, Africa, writes that within the past few years, wireless telegraph stations have been established at five points on the Italian Benadir coast and on the islands of Zanzibar and Pemba.

Additional stations are now being discussed for the mainland at Mombasa, in British East Africa, and in German East Africa. In the latter colony there are telegraph land lines in connection with the railways, and there are also several heliograph stations which are open to the general public.

Companies interested might with profit enter into correspondence with the governor of German East Africa, Dar-es-Salaam (correspondence in German), the governor of British East Africa, Nairobi, and the governor of Uganda, Kisumu.

Electrical League of Cleveland Smoker.

The Electrical League of Cleveland was tendered a smoker by the National Electric Lamp Association at its new auditorium on the evening of Saturday, November 19. An excellent program of entertainment was furnished by members of the engineering department of the National Electric Lamp Association, this consisting of vocal and instrumental music and a number of exceptionally interesting vaudeville performances.

An address was made by A. A. Gray, managing editor of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, on the subject of "Organization." Mr. Gray took for the keynote of his address the development of co-operation and fraternity among electrical men. While individual effort has contributed greatly to the sum of our total accomplishment, individual effort will achieve its highest efficiency only through the medium of beneficent co-operation. Through such organizations as the Electrical League of Cleveland, the spirit of fraternity can best be developed, and the necessary lessons of co-operation can be established, to the development of the individual and the increasing of his influence in the industry he represents. In no way can the spirit of co-operation be made so manifest as it can when through social and pleasant contact those who in the ordinary affairs of the day are natural competitors are brought together under happy circumstances. The Electrical League of Cleveland has a remarkable opportunity for the building up of a strong, influential organization. Cleveland is a very important electrical city, and has the advantage of the location of large industrial organizations, the leading men connected with these institutions being co-operators of the highest degree. What has been done to develop strong electrical clubs in other cities can be duplicated and improved upon in Cleveland, and if the opportunity that now exists is intelligently grasped and the spirit of cordiality which has been worked up be carried up to its logical conclusion, the Electrical League of Cleveland will soon be one of the leading and most influential semi-social electrical organizations of the country.

After the vaudeville and address a substantial supper was served, and this was followed by an excellent minstrel entertainment. During the course of the evening the committees dispensed pipes and tobacco and a great many of those present took the opportunity of inspecting the various features of the engineering building of the National Electric Lamp Association.

Precautions for Linemen.

The death of Willard S. Gray at Palisade, Colo., while stringing a line for the Colorado Telephone Company over wires of an electric light circuit, is the occasion for a full report and a warning of danger, by an officer of the Colorado Company, which is timely and should receive the serious consideration of linemen over the country. A few of the precautions to which attention is called in an unusually forcible manner follow:

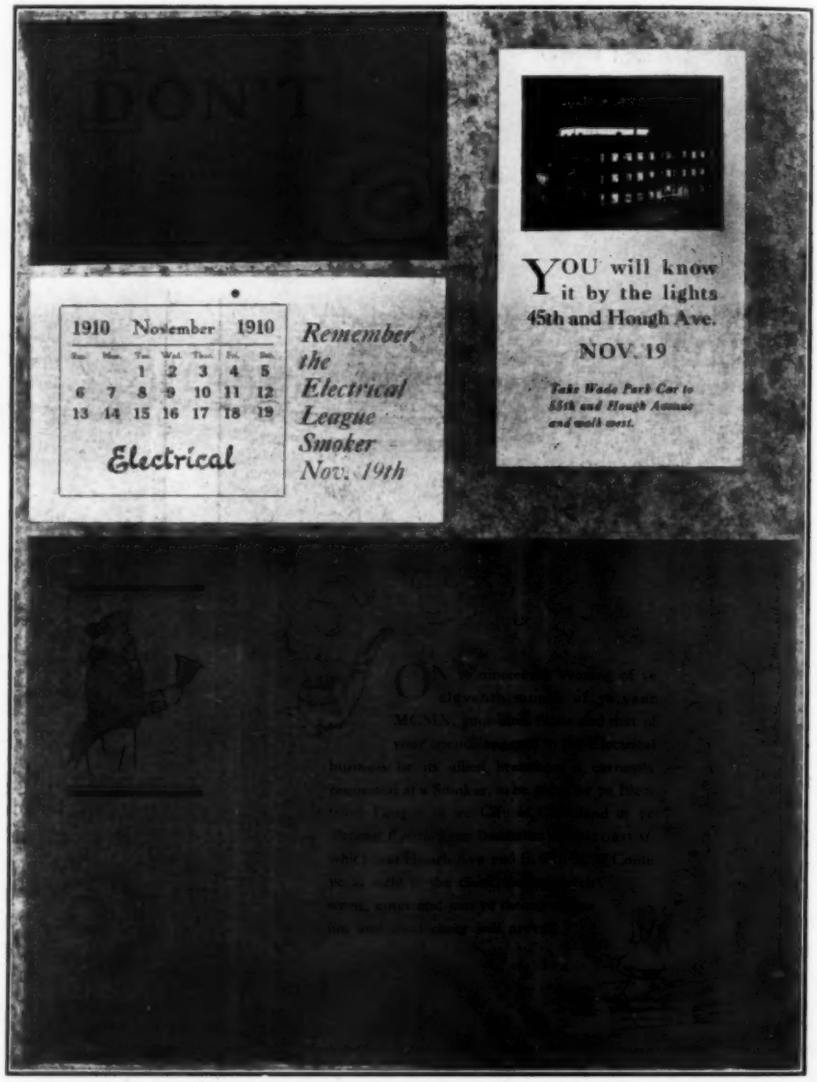
Never assume that an electric light wire is carrying a secondary current.

Do not touch a bare wire when it is in connection with another wire.

Always use a hand line until the wire being strung clears every other wire.

Never assume that the insulation of a light or power wire is sufficient to prevent a dangerous charge being conveyed to another wire in contact with it.

For the sake of those working with you, and for those near and dear to you, neglect no precaution to avoid accidents and secure your own safety and that of your fellows.—*Southwestern Telephone News.*


1910 November 1910
Remember the Electrical League Smoker Nov. 19th
Electrical
YOU will know it by the lights 45th and Hough Ave.
NOV. 19
Take Wade Park Car to 55th and Hough Avenue and walk west.

SOME OF THE NOTICES USED BY THE ELECTRICAL LEAGUE OF CLEVELAND.

The Chicago Railways Company has ordered 200 more pay-as-you-enter cars, which will make 2,500 such cars operated in Chicago.

SOME TYPES OF CIRCUITS FOR VOLTAGE, CURRENT AND POWER CONTROL.—II.

TRANSFER-RESISTANCES AND TRANSFER-COILS.

BY CLARENCE I. ZIMMERMAN.

In the first part of this article it was stated that in the step-by-step type of regulation the main current is transferred from one transformer tap to another without interruption of the power. This operation is performed by means of transfer-resistances or transfer-coils. Transforming devices using transfer-resistances and transfer-coils are thus used very extensively in practice for regulation of feeder voltage, for starting induction motors, for alternating-current arc-lighting systems, and for control of single-phase railway motors and electric furnaces.

A transfer-resistance, as the term is used here, consists of a non-inductive resistance, which is usually designed to carry the normal current in the transformer tap with a voltage drop approximately equal to the voltage of the turns between adjacent taps of a transformer coil. The transfer-resistance circuit is arranged so that when the resistance is used it is either first placed across two transformer taps, and then in series with the main line current, or it is first placed in series with the line and then across two transformer taps. It is finally removed from the circuit entirely. Figs. 1, 2, 2A and 3 show transfer-resistances and their relations to the transformer taps and switches.

A transfer-coil (see Fig. 4) is an inductive coil which is normally left in the circuit and which distributes the main current by reason of its reactive properties between the two transformer taps across which it is connected. When the active transformer taps are to be changed, one of the terminals only of the transfer-coil is moved. This terminal is transferred by means of single-pole switches to a tap on the opposite side of the one carrying the current.

In the Stillwell regulator as it is shown in Fig. 1, when we move the double-fingered slide so as to increase the number of turns in series with the main line, the resistance is first connected across two adjacent taps, then it is put in series with the line and finally it is short-circuited. When the number of turns in the secondary coil of the regulator is being decreased the order of operations is reversed. The resistance is first placed in series with the line, next across the transformer terminals and finally is again short-circuited. This order is followed independently of the direction of the current flow in the main line and independently of the direction of the induced electromotive force in the secondary coil. It will be shown in the discussion of the circuits in Fig. 2, that this is not the best way of using this transfer-resistance where heavy currents are handled and that in some cases it may cause very abnormal burning of the switch contacts and also serious static disturbances on the system. These statements hold not only for the stillwell-regulator circuit as shown but for many other regulator circuits where the order of the introduction and removal of transfer-resistances is not properly followed.

In Figs. 2, 2A and 3 are shown some other types of transfer-resistance circuits. Fig. 4 shows a type of transfer-coil circuit used for single-phase-railway-motor control. The circuits of Fig. 2 will be discussed later.

TRANSFER-RESISTANCES AND SWITCH CONTACT WEAR.

Fig. 2A represents a transfer-resistance circuit which is somewhat similar to Fig. 2, but it is not as satisfactory because it does not allow the minimum switch-contact wear to be attained. The running points are: *B; A* and *C; D; A* and *E*.

The changes from *B* to *E* and return are made as follows: Lowering voltage across load. *B* closed at start. Close *C*, open *B*, close *A*. On running point with *C* and *A* closed. Open *A*, close *D*, open *C*. Next running point, *D* closed. Close *E*, open *D*, close *A*. Last running point, *E* and *A*, closed. The operations which raise the load are made in the reverse order from those which lower the load.

Figure 3 shows a transfer-resistance circuit which is used on some single-phase railways and on some types of electric-furnace regulators. The running points are: *A* and *C; B* and *D; A* and *E; B* and *F*. There are *eight* different orders in which to operate the switches when changing from any one set as *A* and *C*, to the next set, as *B* and *D*. For example, suppose *A* and *C* are closed and we wish to open these and close *B* and *D* without causing any interruption of current flow in the load *L* and without causing short-circuits.

First Method.	Second Method.
Close D.	Close D.
Open A.	Open A.
Close B.	Open C.
Open C.	Close B.
Third Method.	**Fourth Method.**
Close D.	Close D.
Open C.	Open C.
Close B.	Open A.
Open A.	Close B.
Fifth Method.	**Sixth Method.**
Close B.	Open A.
Open A.	Close B.
Close D.	Close D.
Open C.	Open C.
Seventh Method.	**Eighth Method.**
Open A.	Open A.
Close D.	Close D.
Close B.	Open C.
Open C.	Close B.

Several of these methods are practically the same from the standpoint of the burning of the switch contacts. The fifth, sixth and seventh methods are the best. The fifth method avoids the necessity of the connecting wire from the main secondary lead to the middle of the transfer-resistance. A detailed discussion of these circuits will not be given. The circuits of Fig. 2, which are simpler, are to be now taken up in detail.

Referring to Fig. 5, which is the same in principle as Fig. 2, suppose switches *A* and *C* to be closed, and that we wish to reduce the voltage of the secondary in order to lower the normal full-load current to something less than normal. This is done by using the circuit *q-p-D-o-B-L-q* insted of *q-m-C-n-A-L-q*. Assuming the momentary maximum potential of the primary side to be as indicated in Fig. 5, and assuming unity power-factor in the circuit, the maximum potentials and the maximum currents will be as are indicated by the signs and the arrows with double heads.

We can transfer the load from tap *m* to tap *p* in two ways, as follows: To lower secondary load, decrease secondary turns. Switches *A* and *C* closed at start. First method: Close *D*, open *C*, close *B*, open *A*. Second method: Close *B*, open *A*, close *D*, open *C*. Final connections in both cases, *B* and *D* closed.

In following out the first method, suppose switch *D* only be closed. A local current will then flow in the circuit *m-C-n-o-D-p-m*, and in the direction of these letters. Since the transfer-resistance is designed to carry the normal full-load current with a voltage drop approximately equal to the voltage of the turns between the adjacent transformer taps, it follows that this local current has a magnitude approximately equal to the normal full-load current. This local current is represented in the figur: by the arrows with single heads. It is obvious that if we now open switch *C*, we will break twice the normal full-load cur-

rent, and the voltage at which this is broken under the assumed conditions is apparently equal to the voltage *m-p*. The current then flows through the circuit as follows: *q-p-D-o-n-A-L-q*.

Now if switch *B* be closed, and *A* then opened, the transfer-resistance is short-circuited and thus removed from the circuit. The opening of *A* occurs without any effect upon the flow of current and consequently its contacts are not called upon to break any load.

We assumed that the load *L* was non-inductive, and that the transfer-resistance was practically non-inductive. In practice, neither of these conditons is fulfilled. So before considering the second method of operating these switches let us see what might happen in practice.

Suppose the transfer-resistance be of the iron-grid type, or an iron wire, or a resistance coil of any type containing only a small or perhaps a considerable inductance. By noting the directions of current which flow through the transfer-resistance just before and just after the opening of switch *C*, it is seen that a reversal of current occurs. The more quickly switch *C* is opened, the more quickly must the current in the transfer-resistance be reversed. The properties of all inductive circuits are such that the electromotive force of self-induction, when the current is dying out or being reversed, is in the direction of the original current and its magnitude depends upon the rate of change of the current. The electromotive force of self-induction in this transfer-resistance is opposed to the electromotive force of the coil *q-p*. It was the opening of switch *C* that caused this electromotive force of self-induction to be set up, and when switch *C* is opened, the main current cannot flow through switch *D* until this magnetic energy is dissipated. Thus switch *C* may be called upon to break *twice* the full-load current at a voltage equal—not to *p-m*—but to *q-m*, which is the full voltage of the transformer. Furthermore, the load *L* is also inductive, and it has an electromotive force of self-induction which adds to the transformer voltage *q-m* and the two are concentrated in series upon switch *C*.

The magnitude of the potential concentrated upon switch *C* when it is opened in practice, depends upon the rate of opening the switch, upon the magnitude of the inductance of the transfer-resistance, and upon the magnitude of the self-induced electromotive force from the load *L*. It may also be intensified by the inductance of the transmission line and of the generator supplying the primary of this transformer.

The second method of operating the switches eliminates these troubles entirely. In Fig. 6, suppose that switch *B* be closed and *A* opened before closing *D* and opening *C*. The result is to break the normal load current when inserting the transfer-resistance in series with the load, and if practically the normal current be still flowing in the circuit, the voltage drop across the resistance will be equal to *m-p*. In practice, at the moment of opening *A*, the voltage at the switch contacts is higher than the voltage drop across *n-o* because the inductance of *n-o* prevents an instantaneous rise of current in the circuit. This opposition is not nearly so serious, however, as in the case where an electromotive force of self-induction forces a discharge against the impressed pressure. When switch *D* is closed, there is no change of the circuit conditions for *o* and *p* are at the same potential. When switch *C* is opened, the main current is made to flow in the circuit *q-p-D-o-B-L-q*, instead of the circuit *q-p-m-C-n-o-B-L-q*. Switch *C* breaks the local transfer-resistance circuit only and the wear on the contacts is small.

It is obvious from the above discussion of these two methods that the proper way to decrease the load in the circuit shown in Fig. 2 is to first place the transfer-resistance in series with the load and then to connect it across the adjacent transformer terminals, and then to remove it from the circuit.

Suppose we wish to *raise* the load *L* by increasing the potential of the secondary. There are again two methods of making the change (see Figs. 7 and 8). To raise secondary load, increase secondary turns. Switches *B* and *D* closed at start.

First method: Close *C*, open *D*, close *A*, open *B*. Second method: Close *A*, open *B*, close *C*, open *D*. Final connection, *A* and *C* closed.

When the first method is used, a local current tends to flow in the circuit *p-m-C-n-o-D-p*, (Fig. 7). The normal current, however, was flowing through switch *D* in the opposite direction so that when switch *C* is closed as above described, the current in switch *D* will fall to zero. When switch *D* is next opened it breaks no current. Upon closing switch *A*, the transfer-resistance is short-circuited, and when switch *B* is opened there is no current broken. Here, then, is a case where the transfer of the main current from one tap to another is done under full-load conditions without any switches breaking any appreciable currents. This conditon exists only when there are equal currents flowing in the transfer-resistance and in the main line. Under no-load conditions the full-load current in the local circuit is opened when the transfer-resistance is removed from the circuit.

The second method of increasing the number of turns and increasing the load, is first to place the transfer-resistance in series with the line (see Fig. 8), by closing switch *A* and opening switch *B*. Switch *B* breaks the full-load current at a voltage above that of *p-m* because of the small inductance of the transfer-resistance. The potential of the terminal *n* of the transfer-resistance is now below the potential of point *m* by an amount equal to twice the potential of the turns *p-m*. When switch *C* is closed the full potential of the transformer, or *q-m*, is placed upon the load *L* and the current in the transfer-resistance is reversed in direction. This reversal of current causes no trouble because the transfer-resistance in this case has a path in which to discharge its inductive energy, namely, through *A-L-q-p-D*, which is in the same direction as the main current. This reversing occurs upon closing a switch and not upon opening one. The transfer-resistance now acts as an unnecessary load on the transformer. When switch *D* is now opened it breaks the local transfer-resistance current without damage. There is of course a small amount of inductive energy to be dissipated when this local circuit is opened, but switch *D* is capable of handling this.

A brief consideration of these last two methods shows that the former is the better because at full-load it causes no wear of the switch contacts whatever, whereas in the latter the normal full-load current has to be broken twice.

The circuits discussed so far include the four possible cases which are presented when the regulation is performed from the secondary side of the transformer. There are four more cases to be considered, namely, when the regulation is performed from the primary side. On account of the difference in the directions of current flow in the primary and

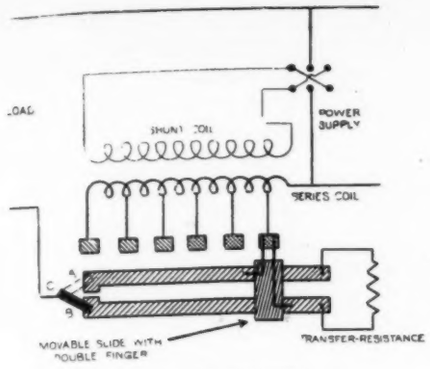


FIG 1- STILLWELL REGULATOR

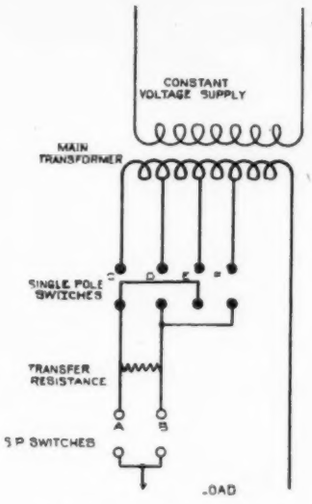


FIG. 2-TRANSFER-RESISTANCE CIRCUIT

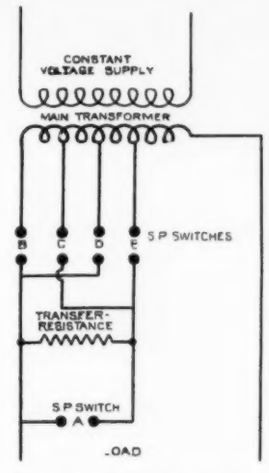


FIG 2A-TRANSFER-RESISTANCE CIRCUIT

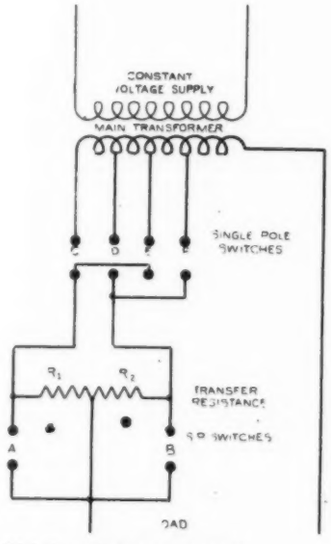


FIG 3-TRANSFER RESISTANCE CIRCUIT

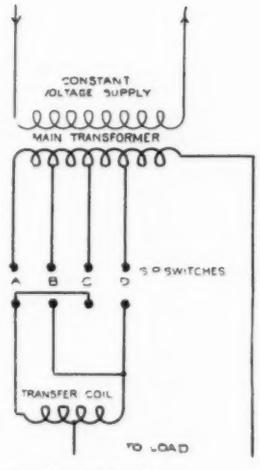


FIG 4 TRANSFER COIL

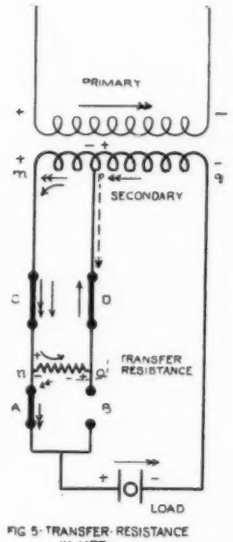


FIG 5-TRANSFER-RESISTANCE IN USE

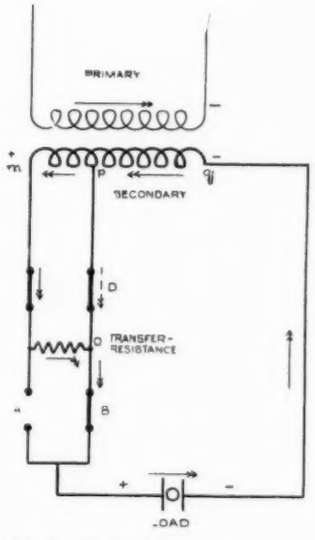


FIG 6-TRANSFER-RESISTANCE IN USE

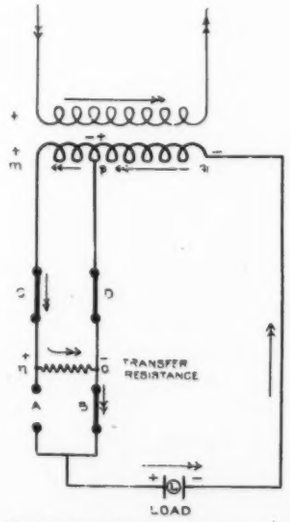


FIG 7-TRANSFER-RESISTANCE IN USE

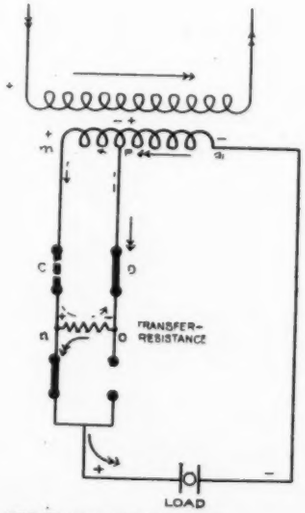


FIG 8-TRANSFER-RESISTANCE IN USE

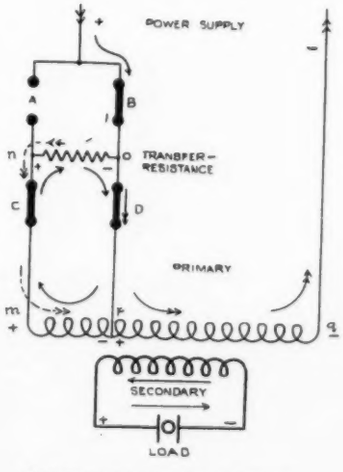


FIG 9-TRANSFER-RESISTANCE IN USE ON PRIMARY SIDE

TYPES OF CIRCUITS FOR VOLTAGE, CURRENT AND POWER CONTROL.

secondary coils the order of operating the switches when the number of active turns in a coil is to be increased or decreased, is not the same. Among the four cases on the primary side there is one which causes very serious trouble, just as there is one of four which causes trouble on the secondary side. This is shown and partly described in Fig. 9. These four cases will not be here described in detail for the method would be very similar to what has already been given. The burning of the switch contacts, and the serious static effects are liable to be even more serious. The self-induced electromotive force in the transfer-resistance has to oppose a much higher electromotive force when the primary line is a high-voltage circuit.

It requires only a moderate inductance in the transfer-resistance circuit to cause trouble. Changes in the power-factor of the load and in the rate of breaking the contacts of switch *D* (Fig. 9) will affect the conditions markedly. Furthermore, it does not require a highly inductive load nor an abnormal load at *L*, to sometimes cause the most startling destructive and explosive effects in an oil switch where *D* is located. There may also be very serious potential rises throughout the whole system. When there is a large overolad at *L* and we attempt to reduce it by the wrong method, the conditions may be still worse. The writer has seen a case of this kind where, even with a load less than normal, well designed oil switches containing the best grade of oil were incapable of opening the transfer-resistance circuit without explosions in the oil tanks and almost complete destruction of the switch contacts. He has also seen other cases showing different degrees of this trouble.

By comparing the circuits which are presented by the eight different cases above mentioned a general rule can be deduced which will tell us how the transfer-resistances should be used without figuring the directions of the currents in every instance. A summary of the correct methods of using the transfer-resistances is first given.

Regulation by Changing Secondary Taps.—1. To *decrease load, decrease* active *turns* and first insert the *transfer-resistance in series* with the line. 2. To *increase load, increase* active *turns* and first place *transfer-resistance across transformer taps.*

Regulation by Changing Primary Taps.—1. To *decrease* load, *increase* active *turns* and first insert *transfer-resistance in series* with the line. 2. To *increase* load, *decrease* active *turns* and first place *transfer-resistance across transformer taps.*

The rule which is drawn from this is: "When the *load* to be controlled is to be *increased,* the transfer-resistance should be first connected so that it will act as an additional load on the feeders, that is, it should be first placed across the adjacent transformer taps; and when the *load* is to be *decreased* the transfer-resistance should be first inserted so as to absorb part of the power which would otherwise go to the load, that is, it should be placed in series with the line."

It is well to point out further that if this rule is followed the variations in the secondary voltage and of the load on the feeder during the period of changing will be smoother than if it is departed from in any case.

When we analyze the Stillwell regulator circuits as shown in Fig. 1 we find that as long as the direction of the voltage in the series coil of the regulator adds to the voltage at the load end, the operations are correctly performed, but when the reversing switch in the primary side is moved so as to make the voltage of the secondary coil oppose that of the voltage on the load, the circuits will be such as to cause an instantaneous reversal of the direction of the current in the transfer-resistance circuit. In heavy-power work there is thus introduced a possible source of serious trouble. This trouble may be averted by placing a switch in the circuit so as to connect either end of the transfer-resistance, as *A* or *B*, to the main line, *C*. The position of this switch is shown by the dotted line. Whenever the series-coil potential adds to the potential of the supply, *B* and *C* should be connected, and whenever the series potential acts in opposition to the potential of the supply, *A* and *C* should be connected. The insertion and removal of the transfer-resistance will then conform to the rule which has been deduced. This extra switch should be operated by the reversing switch handle which controls the polarity of the shunt coil. The reversing switch should be operated only when none of the series coils are in the circuit, and the transfer-resistance switch should be made so that it will not open-circuit the line.

In large regulators of the type shown in Fig. 2, the proper order of switching should be obtained by means of a mechanically interlocked switching mechanism, or if the switches be operated electromagnetically, their sequence should be in the proper order.

Where only moderately severe troubles are found in existing installations due to the incorrect method of using transfer-resistances, and where the switch mechanism and the circuits are such that it would necessitate complicated or expensive changes, it may be advisable to leave the switch sequences as they were designed or installed and to use some auxiliary devices to reduce the intensity of the trouble. The transfer-resistance should be made as nearly non-inductive as it is possible to make it. All iron should be removed from this resistance whether it be an iron-wire resistance, or an iron-grid resistance, or a coil of any resistor wire having iron in its neighborhood. An electrical condenser or an electrolytic safety-valve might be used to advantage, in some instances, across the terminals of the transfer-resistance to reduce the momentary high-potential rises. An electrolytic cell of the aluminum-electrode type will serve as a condenser and also as an electrolytic safety-valve. A small change in the rate of opening the switch may also be sufficient to reduce the troubles.

In the concluding part of this article, the subject of transfer-coils will be considered.

DIAGRAMS.

Fig. 1.—*Stillwell Regulator Circuit.* Used largely for feeder regulation.

Fig. 2.—*Transfer-resistance circuit.* This type is used in some power installations for electrometallurgical purposes. The running points are: *A* and *C; A* and *E; B* and *D; B* and *F.*

Fig. 2A.—*Transfer-resistance Circuit.* This type of circuit is simpler than Fig. 2, but it is not as satisfactory because it does not allow the minimum switch-contact wear to be attained. The running points are: *B; A* and *C; D; A* and *E.*

Fig. 3. *Transfer-resistance Circuit.*—This type of circuit is used on some single-phase railways and on some types of electric-furnace regulators. The running points are: *A* and *C; B* and *D; A* and *E; B* and *F.*

Fig. 4. *Transfer-coil Circuit.*—A type used on some single-phase railways. The running points are any two adjacent single-pole switches.

Fig. 5. *Transfer-resistance Circuit.*

(*See Fig.* 2)—This circuit shows the current flow and the potentials at one period of the switching operation when *lowering* the secondary load according to the *first method*. Switches *A* and *D* are closed. The broken-line arrows show the current after opening *C*, and the arrows in full lines show the currents before opening *C*.

Fig. 6. *Transfer-resistance Circuit.* (*See Fig.* 2)—This circuit shows the current flow and the potential at one period of the switching operation when *lowering* the secondary load by the *second method*. Switches *C*, *B* and *D* are closed. The opening of switch *C* causes the main current to flow through *D* and it breaks the full-load current at the voltage *m-p* across the transfer-resistance, besides absorbing the inductive discharge of the transfer-resistance at the switch gap.

Fig. 7. *Transfer-resistance Circuit* (*See Fig.* 2)—This circuit shows the current flow and the potentials at one period of the switching operation when *raising* the secondary load by the *first method*. Switches *C*, *B* and *D* are closed. When opening *D*, no current is broken. When *A* is closed and B opened, *B* breaks no current. The full-load current is here transferred from *D* and *B* to *C* and *A* without breaking any appreciable currents.

Fig. 8. *Transfer-Resistance Circuit.* (*See Fig.* 2)—This circuit shows the current flow at one period of the switching operation when *raising* the secondary load by the *second method*. Switches *D* and *A* are closed. Closing *C* increases the load *L* and reverses the current in the transfer-resistance, but without any serious troubles at the switch contacts.

Fig. 9. *Transfer-Resistance Circuit* (*See Fig.* 2)—This circuit shows the current flow at one period of the switching operation when the regulation is being performed from the *primary* side of the transformer. This order of operating the switches is *incorrect*. Switches *B* and *D* are closed at the beginning of these operations. When *C* is closed later, a local current flows as shown by the arrows with single heads. Opening *D* breaks twice the full-load current and *reverses the current* in the transfer-resistance circuit, causing trouble at switch *D*.

(*To be continued.*)

As a step toward more economical production the Hamilton Manufacturing Company, Lowell, Mass., is installing additional electric motors in its factory.

Tests of Insulating Materials.

The American Society for Testing Materials has appointed a committee on Standard Tests of Insulating Materials, known as Committee D-9, of which C. E. Skinner, of the Westinghouse Electric & Manufacturing Company, is chairman.

The committee desires to secure from manufacturers, users and testing laboratories information in detail as to the methods pursued in making the regulation tests. With this information at hand, it is hoped that the more important of these tests may be standardized. At the present time the testing of insulating materials is in a very chaotic state, due to lack of standard methods and standard tests. Each producer and each consumer has his own tests. But these almost invariably differ from those used by others. There are certain fundamental tests which are required in all classes of insulating materials; it is thought that the standardization of these tests will be of direct benefit to producer, consumer and independent testing laboratory.

The information desired is that pertaining to testing methods, not to the insulating materials themselves. In order that the work of the committee may be satisfactorily accomplished, it is necessary that all the details be given, not only of the methods of testing, but also the manner of preparing samples. For instance, in preparing samples of insulating cloth, the kind of cloth used is important, how it is prepared for treatment, how the insulating material is applied to the cloth, at what temperature and density it is applied, etc.

Since the deterioration of insulating materials with time is an important matter, it would be desirable to be able to predict the life of the material in service from the fundamental tests on the new material, if this can be done. The list of tests given below is intended to cover all the important properties of the whole line of insulating materials. No one material, of course, would be subject to all these tests.

Anyone interested in the subject of these tests is requested to communicate with H. B. Brooks, Bureau of Standards, Washington, D. C., giving the information indicated. Partial replies will be welcome, even though relating to but one material or test in the following list. The committee wishes opinions as to the advantages to be derived from such tests, and which tests are most important.

LIST OF TESTS.

Electrical Tests: Dielectric strength (puncturing voltage); relative dielectric hysteresis; specific inductive capacity: (1) direct-current; (2) alternating-current; conductivity or insulation resistance; leakage.

Physical Tests: Specific gravity and specific weight; hardness; toughness; brittleness; ductility; workability; flexibility (with reference to varnished cloths, etc.); tensile, compressive and shearing strength; fibrous, crystalline and amorphous fracture; ability to take polish; melting point; softening point; shrinkage; adhesiveness; effect of high temperature (electric arc); effect of low temperature (extra cold); artificial aging test; porosity; viscosity; flash and fire test; film-making power; rate of drying; penetration; absorption of moisture; amount of volatile matter given off at prescribed temperatures.

Chemical Tests: Proximate composition; solubility in water, oil, etc.; effect of moisture and moist air; weathering qualities; chemical effect upon metals in contact; presence of acid.

Railroad Men Visit University of Illinois.

A party of about fifty railroad men visited the college of engineering of the University of Illinois, at Urbana, on Wednesday, November 9. The party was composed of executive and engineering officers of the railroads having headquarters in Chicago and operating in near-by territory.

The visit was made upon the invitation of Dean W. F. M. Goss. Its object was the inspection of the buildings and equipment of the college of engineering, and a discussion of the possibility of a closer educational alliance between the railroad service and the University.

After a trip of inspection over the plant of the college of engineering, an informal conference was held between the railroad officials and the heads of departments of the college. Resolutions were passed by the visiting party expressing an appreciation of the need of the college for better facilities and more complete equipment, especially along the lines of railway and transportation engineering, for study and investigation.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

ELEMENTS OF POWER-STATION DESIGN—XIII.

INSTALLATION DETAILS.—II.

BY W. B. GUMP.

Structural Types.—The chief aim in designing a bus structure is to have the connections as simple and direct as possible. The simplicity of arrangement in a given power station may often be favored by a particular type of switch. Fig. 5 illustrates a typical 12,000-volt structure, using bottom-connected switches. It is evident that this type of switch affords more direct connections than a top-connected switch in the same relative position. In other words, the top-connected switch should preferably be located below, with the bus structure above, unless other factors are decidedly unfavorable. Present practice is abandoning the bottom-connected type of switch and replacing it with the top-connected type in the majority of systems. The top-connected switch offers greater all-round flexibility than the other type, and can generally be made to accommodate the most favorable arrangement of bus structure. Fig. 6 shows a 12,000-volt bus system with top-connected switches.

The material most commonly used for switch cells is concrete. This may or may not be reinforced, depending upon the thickness of the walls. In most plans the switch cells are molded in wooden forms set in the final location for the switches. In a number of plants the concrete slabs, partition walls, and the like are molded in portable forms and cemented in their proper position after hardening. A third method is to erect wire fabric, metal lath, or a similar reinforcing material, and follow it with a thorough course of cement plaster which is given a finished surface. When complete this structure is practically monolithic in character, and absolutely fireproof. Fig. 7 shows the construction of compartments containing high-tension current transformers. Barrier walls are spaced between groups but not between individual transformers. Fig. 8 is a bus and switch structure which shows the bare construction previous to installing the switches. The barriers do not extend above the lower outgoing leads from the switches, dependence being placed upon the insulation of the switch leads, and the spacing of the conductors above. The openings above allow the proper connections to be made with the busbars which carry three-phase current at a potential between conductors of 33,000 volts. A type of construction without barriers between disconnecting switches is shown in Fig. 9, in which the conductors entering the switch bushings are insulated with empire cloth, each pair being protected from the adjacent pair by means of a barrier. Where it is desired to install the busses below, it becomes necessary to spread out the conductors, and carry them between barriers behind the switch cells. This method is shown in Fig. 6.

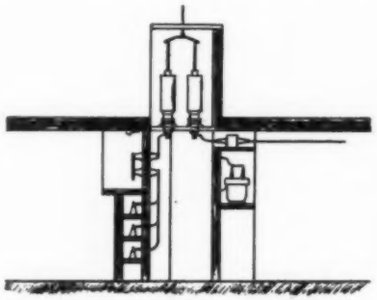


FIG. 5.—TYPICAL 12,000-VOLT BUS STRUCTURE, USING BOTTOM-CONNECTED SWITCHES.

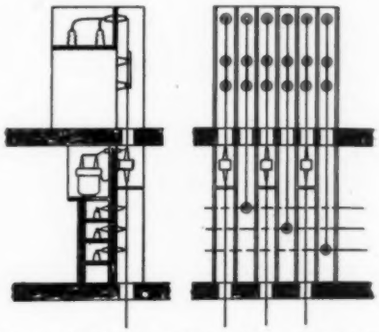


FIG. 6.—TYPICAL 12,000-VOLT BUS STRUCTURE, USING TOP-CONNECTED SWITCHES.

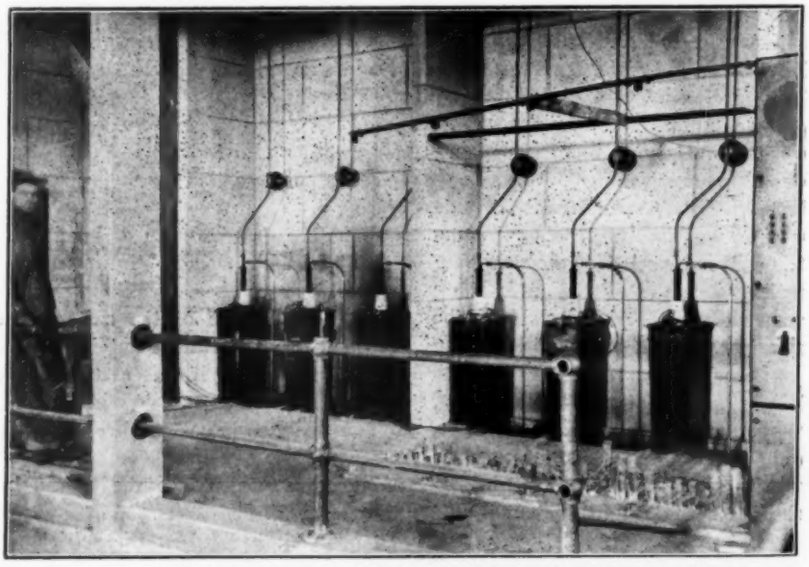


FIG. 7.—COMPARTMENTS CONTAINING HIGH-TENSION TRANSFORMERS.

High-Tension Apparatus.—It is understood that the treatment of so broad a subject within one article is extremely limited. It is well, however, to take up some of the salient features relating to the high-tension side, and show the chief items to be considered in the design and construction of this portion of the plant. It is clear that the term "high tension" is relative, and may mean 6,600 or 66,000 volts, according to the particular plant in question. In the following it is understood that a potential above 33,000 volts is considered high tension, and therefore the 12,000-volt systems, before referred to, will not be included.

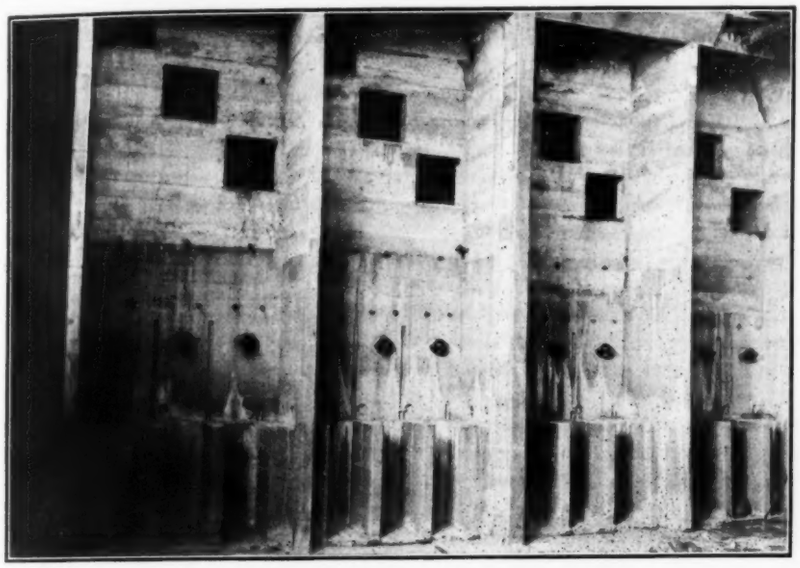


FIG. 8.—BUS AND SWITCH STRUCTURE, BARE.

Due to the fact that high-tension appliances demand a liberal amount of room it is evident that not only the wiring scheme but the arrangement of apparatus will exert a marked influence upon the first cost, as well as efficiency in operation. The elimination of all unnecessary structures and devices is to be sought in designing the most practical and economical system.

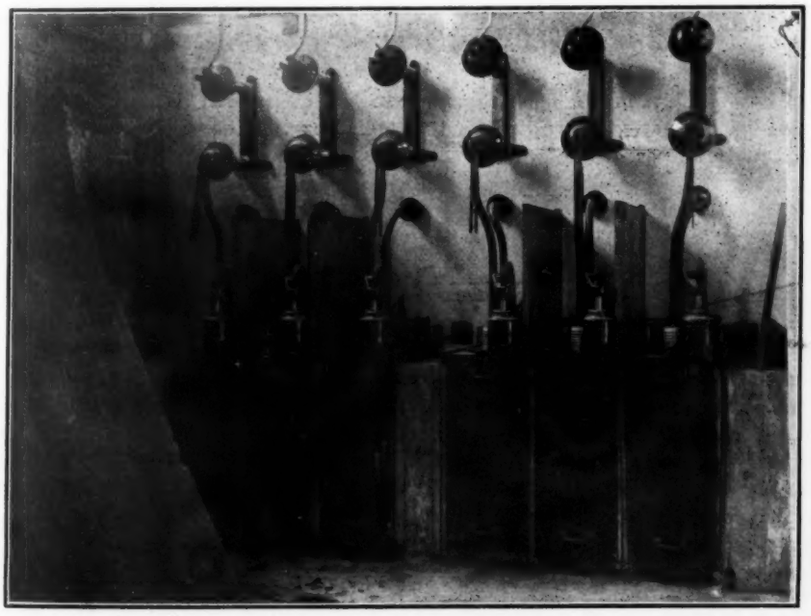


FIG. 9.—NO BARRIERS BETWEEN DISCONNECTING SWITCHES.

The high-tension system in a typical plant is made up of: (*a*) High-tension busses; (*b*) high-tension oil switches; (*c*) high-tension oil-insulated current transformers; (*d*) lightning arresters; (*e*) choke coils; (*f*) structures for containing these elements.

Simplicity in the high-tension side of a plant means much as to first cost and (hence) the investment charges. The arrangement finally adopted is always a compromise between maximum flexibility and minimum first cost. The proper place to draw the line between these opposing factors, is the thing to be determined. Hence considerable experience upon similar plants combined with good engineering judgment is required.

It is generally feasible to sectionalize the high-tension bus, and in such cases a single high-tension bus is usually sufficient. The extra investment involved in a two-bus system is thus eliminated. The operation of the plant is simplified as well. This assumes that there are a large number of outgoing lines which may be operated free from the high-tension busbars. Otherwise it would be difficult to find an opportunity to clean or repair certain portions of the bus.

The chief bugbear of high-tension development is the great amount of space required for switching apparatus. Since the chief source of interruption is on the transmission lines the switching system cannot be slighted, but must have sufficient flexibility for meeting emergencies. However, if too flexible it becomes overburdened with operating difficulties, and the purpose sought is defeated.

In detailing the high-tension system a vast number of ways of accomplishing the desired results will appear. When attempting to reduce the floor space the headroom is generally increased. Here again is a compromise between height and floor space, and the result will be based principally upon the minimum cost of accomplishing the requirements in the simplest manner possible.

Many arguments have been presented in favor of installing the main-line switches out of doors, instead of in the main building, and it appears that this plan is entirely feasible in a large number of instances. The cost of the building for the station is thereby considerably reduced, and a certain amount of danger relative to operation is removed. The main point to be taken into account in connection with out-of-door

switches is their security against extreme weather conditions. There is every reason to believe that this difficulty can be overcome. In fact it has been overcome in several systems, and has accordingly shown the practicability of this method of construction.

Lightning arresters can also be installed out of doors if amply protected. As these appliances are a source of considerable danger in many localities, the advisability of placing them outside the building deserves careful attention. They should be well housed, and protected from rain, snow, and dust. The cost of inclosing them outside the main building and adjacent to it, need not be as great as the cost of placing them within, since the latter arrangement demands a larger building than is required with an outside installation. A wing compartment or housing may readily be built on the end carrying the high-tension lines, and an entrance made into this compartment from the inside of the station. The compartment may be constructed of metal lath, plastered with cement, or may be suitably constructed of corrugated iron held upon a metal framework. This depends upon local conditions.

It is of the highest importance to provide for convenient removal of transformers, and all other portable apparatus. Lack of respect for this is apt to result sooner or later in sadly hindering the operation of the plant. It is not usual to provide for the lifting of oil switches, either high-tension or low-tension. In most instances it is advisable to prepare a means of removing the operating mechanism, and this can usually be done with the assistance of the crane (at least on the low-tension side) when the switches are located on the main floor. The difficulty of removing the high-tension-switch mechanism is augmented by interference with the high-tension leads, and on that account the switches and appurtenances are considered permanent, and are rarely removed or altered after the original installation.

Installation of Auxiliary Wiring.—The control and instrument wiring is usually installed in iron conduit, as this material is easily bent to any desired curve and is a permanent protection to the wiring, whether the conduit is imbedded in concrete or exposed. The minimum allowable radius should be eighteen inches, except at the ends of pipes terminating in a bend which can be removed. The pulling may then be done through the straight section and the bend placed on the wire afterward, and secured in place. Such bends may have radii as short as four or five inches.

The station lighting circuits should also be inclosed in iron conduit. Cases are rare where fiber is preferred for this work, since high insulation is unnecessary, and fiber does not withstand mechanical exposure to which certain portions of lighting conduits are generally subjected.

Exciter and Direct-Current Power.—The exciter switchboard should contain two sets of busses, one panel for each exciter, a panel for each generator field, and a sufficient number of panels to handle all of the local direct-current supply to motors, local lighting, storage battery (if there be one) and any other apparatus demanding low-voltage direct current within the station. A potential of 220 volts is recommended for exciters, and local direct-current power service. It is generally advisable in large stations to have two exciters and a motor-generator. The latter may be used ordinarily for power-station lighting, for operating crane motors, compressors, and the like. In this way the exciter system is not interfered with if connected to a separate bus, as above suggested.

For field excitation of generators above 2,000 kilowatts, a capacity of not less than three per cent of the rated output should be installed. With control, local lighting, and direct-current power supply, the exciter capacity will be increased proportionately. It is well to have the exciters and motor-generator of the same capacity, so as to permit complete interchangeability.

As a rule the exciters are compounded with practically a straight-line relation, regulation being governed chiefly by the alternator field rheostats. In some plants the compound coils of the exciters are not used, but the exciter voltage is varied by means of its own field rheostat.

The advantages of a storage battery in conjunction with the exciter system are deserving of careful consideration especially in a large station where interruptions in service are prohibitive. Aside from the advantage of a storage battery for field excitation is the fact that it serves as a means of lighting the station during an emergency, and also furnishes an ideal source of current for laboratory and testing purposes in connection with the plant. The utility of a storage battery is generally more marked in the case of substations than in generating stations. The range of usefulness in the latter is naturally more limited, since there is likely to be some power available at all times. This is not the case with a substation of which the source of supply is at times completely cut off.

Crane and Appurtenances.—Every power station, large or small, should be provided with a crane of sufficient capacity to hoist the heaviest single piece of machinery. In most plants of less than 5,000 kilowatts a hand-operated crane is satisfactory. For larger plants an electric traveling crane is generally required.

The span of a crane should be governed by the width of space required to include all heavy parts of apparatus to be lifted. In most stations the apparatus to be manipulated by the crane is limited to the generators and transformers. In a steam plant the engines and heavy piping require crane facilities. It is not feasible to carry the crane over the high-tension portion for two reasons. First, there is practically no demand for lifting the oil switches, due to their permanency of construction. Second, it is better to avoid handling even the heaviest high-tension appliances with the crane, on account of coming in contact with live conductors. The latter danger is sufficient cause for barring the use of a crane on the high-tension side. The cost of a crane increases in proportion to the span, and represents an investment which should be made as low as possible. While this fact is well known, yet it is not always heeded, and the result is an increased cost without any added advantages.

In conclusion a word may be said respecting the building. In almost all large stations the advice of an architect is sought when planning the station building, and in many instances there is a clash between the purely architectural and the engineering side, accounted for principally because the architect is rare who can combine architectural beauty with substantial engineering construction. This seems to be the reason why few American plants are more than unsightly bare buildings in ap-

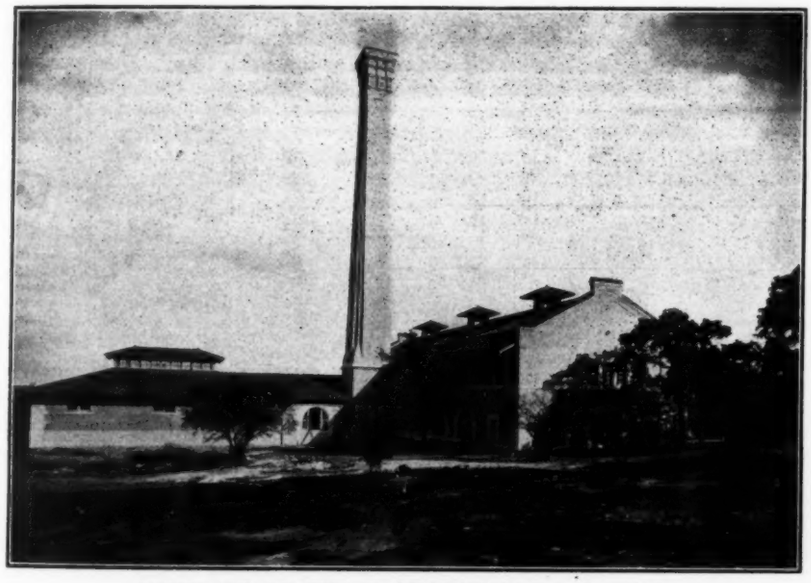
pearance. With little or no added cost, a building may be adorned architecturally, and made to harmonize with the surroundings in a commendable manner. The utilitarian point of view is apt to overshadow all other features, and the result is inevitably a structure greatly inferior to that which would be justified in the locality in question. Even with concrete construction a building may be built to conform to architectural lines, and this fact is worth keeping in mind when designing power-station structures.

(To be continued.)

EDITOR'S NOTE.—This important series of articles started in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 3, 1910, and will cover every phase of central-station design. The treatment is elementary and withal practical throughout, and the complete series will constitute a standard and reliable treatise on this important subject.

Power and Heating Plant of the University of Texas.

It is claimed by competent engineers that the new electric power and heating station which has just been finished at the University of Texas in Austin is one of the most complete and modern plants of its kind at any educational institution in this country. The cost of the building and equipment was approximately $100,000. The station serves a combination of useful purposes. In addition to providing power for the several buildings that comprise the University, it has in reserve sufficient electrical generators to furnish lights for the institution should the lighting current that is received from the municipal plant of Austin be cut off or interupted at any time. It is also equipped with the necessary apparatus for a steam laboratory for students of electrical engineering and contains the shops and shop equipment for students who take manual training in wood and iron.



POWER AND HEATING PLANT, UNIVERSITY OF TEXAS.

The building is of attractive architecture and is constructed of concrete, stone and brick. The roof is supported by angle-iron trusses and covered with tiling. The boiler room is equipped with two 200-horsepower and two 100-horsepower Babcock & Wilcox boilers. One of the boilers is built for 250 pounds working steam pressure and has a superheater for raising the temperature of the steam 200 degrees Fahrenheit. This boiler is fitted with an automatic stoker which was donated to the University by the Green Engineering Company, of Chicago. One of the 200-horsepower boilers has a chain-grate stoker attached, which was the gift of the same company. These automatic stokers insure the scientific firing of the boilers. The gases distilled from the coal pass back over a white-hot cinder bed and are thus thoroughly consumed.

The extra heavy flanged piping with which the boilers are fitted enables them to be operated normally at 160 pounds gauge pressure, with the exception of one referred to which carries 250 pounds. From the boilers the steam passes to the pump room, where a steam header is placed, and reducing valves are used for lowering the high pressure to that required by the various buildings. In the pump room are six vacuum and boiler-feed pumps, receivers, hot-water drums and other equipment. Boiler steam heats the water for the gymnasium and other baths. A large receiver for holding condensation from the various buildings until the water is used again in the boiler is located just outside the pump room. The two tunnels that lead to the different buildings are about 1,000 feet long and contain about 10,000 feet of steam piping. The plant will furnish live steam to the engineering and chemistry buildings, and to the bureau of economic geology. The floors of the different rooms comprising the plant are of concrete.

An arrangement of the boiler headers is so made that one or all or any combination of boilers may be used. All mains are equipped with nonreturn valves.

The water feed line runs under the furnaces through the ash tunnel. Each boiler is furnished by separate feed lines and may be fed by either pump or injector. On the main feed line, between the pumps and the boilers, there is a safety valve.

Coal is unloaded from wagons direct into the bins which are conveniently arranged. Weighing equipment is provided. The ashes fall into hoppers underneath the grates and are thence transferred to an iron car that moves on a track underneath the boilers. On this track is a set of scales where the ashes may be weighed.

The steam-laboratory equipment consists of two steam turbines, a compound Corliss engine, a two-stage air compressor, a duplex steam pump and apparatus for testing injectors, inspirators, air orifices, steam nozzles, indicator springs, gauges, and other apparatus. A seventy-five-horsepower producer-gas engine will be installed in the laboratory for testing purposes.

In connection with one of the steam turbines is a seventy-five-kilowatt generator. The condensers and condenser pumps are situated in the basement of the building. Other rooms are equipped with shop machinery for working in iron and wood. The machine and woodworking tools are all driven by individual motors. T. W. Hall is chief engineer of the plant.

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

THE BEST LIGHTED BUILDING IN THE WORLD.[1]

BY JOSEPH A. MC MEEL.

The initial illumination of the Denver Gas & Electric Company's new million-dollar building at Denver was held on the evening of November 12. Somewhere in the neighborhood of 50,000 people flocked to the vicinity to see the effect of the best lighted building in the world. The streets were packed from sidewalk to sidewalk. The crowd extended over a radius of six blocks. It was the largest crowd that has ever assembled on the streets of Denver.

About fifteen minutes before the announced time for the turning on of all the lights the building was shrouded in complete darkness. This was done in order that the contrast might be shown more effectively. A few minutes before 8 o'clock, the time when the building was to be lighted, Mayor Speer and Frank W. Frueauff, general manager of the Denver Gas & Electric Company, mounted the platform erected on the side of the structure where the large button was situated. Exactly at 8 o'clock Mayor Speer pushed the button that turned on all the lighting. As the building burst forth gleaming with the splendor of its electric incandescents, sparkling like a wonderful jewel, and shedding its refulgence upon the great throng below, a great roar went up from the gathered thousands.

Immediately after the turning on of the lighting effects the doors were thrown open to the public. Until midnight a reception was held by the officers of the Denver Company, and long after this hour many still lingered viewing the structure that is a marvel of engineering skill. There is nothing in the whole world that compares with its skill. There is nothing in the whole world that compares with its beauty. From a distance it looks as if it were simply encrusted with light. The glow brightens the very sky and gives the appearance of a great immovable fire.

The interior is a palace of beauty. Office inclosures and counter tops on the main floor are constructed of vitrolite. The furnishings are of imported African mahogany. The interior electric fixtures are of a solid bronze weighing 100 pounds each.

The total number of lamps used in the structure is 13,000, their candlepower equivalent being 200,000. Bryan-Marsh Mazda lamps are used throughout. Every architectural line and curve blends perfectly with the lighting effect. The second floor is a band of light forming a base for the field over it. The top stories cap the field with a crown of light. Above the windows are huge diadems of light set in crystal globes and over these the cresting is set with jewels of light. The entire structure is a monument to the skill of the illuminating engineer.

The Denver Gas & Electric Company will occupy the basement and the first three floors. On the main floor are the general offices and the private offices of W. J. Barker, general superintendent, and C. N. Stannard, secretary. On the second floor more general offices, including the bookkeeping room, in which an indirect-lighting system, and various departments, are installed. The offices of General Manager Frueauff and Treasurer J. T. Brady are also situated on this floor. The third floor is partly occupied by the advertising department.

THE NEW OFFICE BUILDING OF THE DENVER GAS & ELECTRIC COMPANY—THE FINEST EXAMPLE OF FACADE LIGHTING IN THE WORLD.

The building will be illuminated nightly hereafter from dusk until midnight. It will add renown to the history of Denver as the "City of Lights." It will command recognition from the entire world as the best lighted office building.

1 An account of the exterior lighting of this building was given in these columns in the issue of October 15, 1910.

Chicago Section, Illuminating Engineering Society.

The Chicago Section of the Illuminating Engineering Society held its monthly meeting in the Great Northern Hotel, Chicago, at noon, on November 17. The meeting was preceded by the customary luncheon. The subjects for consideration at the meeting were reviews of the Society's Baltimore convention and of the Johns Hopkins lecture course on illuminating engineering.

Dr. M. G. Lloyd gave a brief résumé of the annual convention, which he characterized as most successful not only in attendance but also in the excellent quality manifest in all the papers presented. Of the various papers, three were particularly noteworthy. That by Mr. Macbeth on the characteristics of gas lamps under pressure was a valuable contribution to this important subject. Mr. Millar's paper on street illumination aroused much interest, because it pointed out the importance of the silhouetting effect in street lighting. Those who had made observations of this feature were struck by the difficulty in discerning objects on oiled macadamized roadways where the dark background of the pavement prevented any reflection from distant lamps. Dr. Rosa's paper on photometric standards showed the feasibility of a flame standard as a primary standard.

George C. Keech began the review of the Johns Hopkins lecture course by summarizing the lectures of Dr. Jos. S. Ames and L. B. Marks. Dr. Ames gave three lectures on the physical basis of the production of light. He advised every one who had anything to do with measurements to doubt the accuracy of his instruments, of his readings, and in fact of everything until it was proved the least possible error would result. His second lecture showed the importance of the black body radiation and absorption. In his third lecture he called attention to the property of fluorescence by means of which reflectors are now being made to supply the mercury-vapor light with red and yellow rays. The three lectures by Mr. Marks had to do with the principles and design of interior illumination. In his first lecture he called attention to the large number of experiments made with prismatic windows in the endeavor to get more daylight into large rooms. He also placed much importance on placing artificial illuminants so that their rays would have the same direction as those received in daytime. The second lecture dwelt on the various systems of illumination, such as direct, indirect, cove lighting, etc. His third lecture referred to several public buildings whose lighting has been successfully laid out by illuminating engineers with the plans of the building as the only guide.

F. A. Vaughn, of Milwaukee, Wis., reviewed the lectures on the physiological and psychological aspects of illuminating engineering that were delivered by Drs. P. W. Cobb and R. M. Yerkes. Mr. Vaughn first eulogized those responsible for planning such a comprehensive recapitulation of the science and art of illuminating engineering as the lecture course proved to be. The fact that the physiological and psychological features were also considered showed the far-reaching scope of the work. The lectures of Drs. Cobb and Yerkes on these subjects firmly established their great importance in the problems of illumination. This was clearly demonstrated by Mr. Vaughn's recital of his efforts to advise a friend on the proper position of a reading lamp, which advice was not followed, however, and resulted in severe ocular troubles.

George H. Jones took up the lectures of Dr. Chas. P. Steinmetz and J. W. Lieb, Jr. The former had discoursed on electric illuminants, covering in much detail the development of the various classes of electric lamps and their characteristics. He had shown that the arc lamp had its highest efficiency in the large sizes only, whereas the tungstens have the same efficiency regardless of size. The luminous arc is so much superior to the older types of arc lamps that it is bound to replace them. Small carbons make an arc more efficient. Mr. Lieb's lecture was a thorough summary of the electric lighting industry, covering as it did every branch of central-station service.

P. F. Williams reviewed Prof. Whitehead's two lectures on the generation and distribution of electricity for lighting. Among the topics considered were the various systems of distribution, design of electrical systems, voltage regulation, interior wiring, meters, rate systems, etc. Each topic was taken up in some detail.

T. R. Beebe spoke of the lectures by E. G. Cowdery and W. R. Addicks on the manufacture and distribution of gas for lighting. Both the coal gas and carburetted water gas processes were described with their necessary equipment. Various types of burners were discussed and the systems of distribution by low, high and mixed pressures.

W. A. Durgin reviewed the lectures of E. F. Caldwell and Walter Cook on the artistic and architectural aspects of illuminating engineering. Mr. Caldwell dwelt entirely on interior fixtures for gas and electric lighting. He advocated small units, particularly of the candle form for residence lighting. American fixtures are the equal in artistic value to any imported products. Mr. Cook frankly criticised much of the outline lighting that has come into vogue, and was especially severe on what he regards as the hideous electric signs. He said architects need co-operation from illuminating engineers in order to produce an illumination satisfactory from both the scientific and artistic standpoints.

W. P. Lyon spoke of the lectures on exterior illumination that were given by Dr. Louis Bell and E. N. Wrightington. Dr. Bell's lectures were an enunciation of his principles of street lighting that are becoming better appreciated day by day. Besides giving a history of street lighting and its purposes, he showed the need of giving first attention to the police value of such lighting and the folly of providing the same flux of light on secondary as on primary streets.

Chas. C. Schiller took up the lectures of Norman Macbeth and Walton Clark on gas lighting. The former had shown the high value of mantel-lighting and that by means of it any effects attained by electric lighting could be duplicated by gas. Mr. Clark took up the organization and service of a gas company. Mr. Schiller's impressions were that the electric men had been more alive to their opportunities in the lighting lines in the past than the gas men, but the latter were awakening and the competition was bound to be keener hereafter.

Chairman F. J. Pearson briefly reviewed the lectures of Dr. E. P. Hyde, Dr. E. B. Rosa and W. R. Whitney. Dr. Hyde had made a masterful presentation of the physical characteristics of light sources, his two lectures giving his hearers a better and clearer con-

ception of this important subject. Dr. Rosa took up a discussion of primary and secondary standards of light, principally the pentane and Hefner flame standards. His second lecture related to the units and nomenclature that it is aimed to have standardized. Mr. Whitney's lecture dealt with the chemistry of illumination, taking up both gas and electric illuminants.

Norman Macbeth, of Philadelphia, commented on the remarks of some of the other speakers, described the arrangements for publishing the lectures, and briefly reviewed the lecture of V. R. Lansingh, on shades and reflectors. This lecture was an exhaustive exposition of the subject, going into the details of the design, manufacture and use of these accessories.

Improvements in Rochester Street Lighting.

Rochester, N. Y., has for some time been known as a well lighted city, but plans are now being considered for a number of improvements in the lighting of the principal streets.

At present the iron trolley poles of the traction company serve as lighting standards in many sections of the city. Although distances between successive pairs of poles vary somewhat, the average is about 120 feet, with the result that even in cases where lamps are suspended from each set of poles, so great is the distance between lamps that heavy shadows intervene. It is with the banishment of these dark places that the revised plans for illumination have to do.

In the evolving of any new system the artistic will be combined with the utilitarian, and it is planned to convert the plain trolley poles into graceful standards by the addition of ornamental brackets from which to suspend the new lamps which will be tungsten in opalescent globes. A cluster of four lamps will be employed, placed at regular intervals about the trolley pole. The base lines of the trolley poles will also be ornamented.

Lamp-posts modeled after the trolley standards will be placed between the latter, thus cutting down the distance between lamps through the congested district to about sixty feet. The special lamp standards will support, in addition to the four electric bulbs hanging from the ornamental brackets, an opalescent bulb directly at the top of the standard.

It is as yet impossible to estimate accurately how much additional power would be consumed by the new lighting scheme, but it is believed that seventy-five per cent more would be adequate. In the bearing of the additional expense, it is probable that an effort will be made to interest those who would be directly benefited by the improved illumination.

Carbon and Metal-Filament Lamps.

In an address delivered before the Society of Electrical Engineers in Vienna, Hartwig von Löti reviewed the development of the carbon and the metal-filament lamps, and the methods of manufacturing the latter. He also gave some reasons for believing that the temperature of the metal-filament lamp is lower than that of the carbon lamp, and that its higher efficiency is due to selective radiation. In investigating this point, filaments of each kind were secured of the same diameter and length, and operated at such voltages as would give the same specific consumption. The results with a group of lamps are shown in the accompanying table, and demonstrate that the surface per candlepower is throughout about three times as great for the metal filament as for the carbon filament. The latter must therefore have the higher temperature when burning at the same efficiency.

	Carbon Filament				Metallic Filament			
Watts per candlepower	Volts	Amperes	Candlepower	Surface per candlepower	Volts	Amperes	Candlepower	Surface per candlepower
1.0	174.7	0.213	37.00	0.647	20.37	0.65	13.31	1.799
1.5	158.5	0.188	20.00	1.185	16.76	0.58	6.5	3.685
2.0	147.6	0.1738	12.85	1.865	15.21	0.55	4.2	5.70
2.5	140.8	0.1636	9.18	2.61	14.05	0.52	2.96	8.08
3.0	133.4	0.1518	6.75	3.55	13.00	0.505	2.16	11.09
3.5	130.0	0.1447	5.45	4.39	12.16	0.486	1.69	14.19
4.0	126.4	0.1428	4.52	5.3	11.71	0.475	1.38	17.35
4.5	123.5	0.1400	3.84	6.235	11.27	0.46	1.16	20.065
5.0	121.0	0.1360	3.30	7.26	10.73	0.449	0.96	24.98

Uniformity and Contrast in the Lighting of Rooms.

Illuminating engineering is evidently not being neglected in South Africa. A paper on the subject was recently presented at a meeting of the Royal Society in that country by Prof. H. Bohle. An abstract of this paper occurs in a recent number of *The Illuminating Engineer*, London. The author emphasized the important influence of uniformity and contrast in the lighting of a room on the amount of light required, and also discussed the physiological effects of radiation, including the effects of ultra-violet rays.

He considered that when great uniformity prevailed, the amount of light necessary was largely reduced. For example, in a room with black walls, an illumination of thirty-five to forty lux would be required, whereas white ceilings and light walls might reduce this value to thirty lux; when perfect uniformity, such as might be obtained with indirect lighting, was secured, even twenty lux would, in the opinion of the author, give complete satisfaction.

In dealing with glare, Prof. Bohle pointed out that this was mainly due to the fact that when the eye looks at an illuminant of great intrinsic brillianey in front of a dark background, it tries to do two things at once—to open wide for the dark background, and to close up for the bright light. Naturally a feeling of discomfort is the result.

Ornamental Tungsten Lighting in a Small Community.

Plans for a new system of street lighting in the business section of Seneca Falls, N. Y., have been adopted by the Village Board and the Geneva-Seneca Electric Company. Twenty-one ornamental posts are to set in Fall Street from Mynderse Street to the State Bank. The posts will be set alternately on the two sides of the street, making the distance between posts on each side 100 feet.

Each of the posts will contain a cluster of five tungsten lamps, inclosed in frosted glass globes. Four lights will be inverted and one will be upright on the top of the post.

The cost will be made up from the annual lighting appropriation made by the village and the remainder by business interests in Fall Street.

Tungsten Street Lighting to be Extended at Syracuse.

The City of Syracuse, N. Y., has the ambition of becoming the best lighted community of its size in this country. The ornamental tungsten cluster lighting installed a few months ago on South Warren Street has impressed the business men so favorably that a concerted canvass is now being made by a committee of the Chamber of Commerce to secure a uniform extension of the ornamental lighting along all the streets in the business center of the city.

TELEPHONY—TELEGRAPHY, and WIRELESS.

How a Wire Chief Should Conduct His Department.

These words, if taken literally, do not signify much to the average man, says *Telephony*, but if emphasis is placed on the word "should" the curiosity or interest, as the case may be, is at once aroused.

It is the intention here to give a brief résumé of the most important duties of a wire chief, as by doing so, one will fully cover the subject matter indicated by the heading, with special reference to emphasis on the word "should," as it is evident that if a wire chief attends to his duties properly, his department will be properly conducted.

Before going into a general outline of the details which go to make up a day's work for the wire chief, it is well to call attention to the diversified interests and occupations to be looked after of which the layman knows nothing.

A wire chief does not necessarily have to be a college graduate, but he should, at the very least, be thoroughly grounded in Ohm's law and should know the effect of capacity and reactance on the flow of alternating current, if he is to succeed, as the simplest operation of any piece of telephone or electrical apparatus is governed by these rules. He deals with machinery of all sizes and kinds, ranging from gas engines to alternating-current and direct-current motors. He must know how to take care of batteries of various kinds from the largest storage cells to dry batteries. He has to deal with outside construction in all its phases from underground cable to stringing open wires.

He must understand telephone circuits thoroughly. Circuits have to be looked after from the simplest instrument circuit to the most complicated common-battery trunks.

He must look out for not alone the replacement of and maintenance of the above apparatus, but he must do his work with due regard to costs, as it is only a small part of his duties to do the work, but to do it economically calls for the exercise of all his skill and knowledge and the highest executive ability.

The most important item to be considered in the daily routine of wire chief is close attention to trouble reports. As a rule the wire chief will merely assign a case of trouble to a "trouble shooter" and the latter will clear it up, and the matter is forgotten. But to the enterprising wire chief, there is a great deal of significance attached to each and every trouble report.

In the first place, it may be the personal complaint of a subscriber who has gone to the trouble of calling up the complaint girl and reporting his instrument, or it may be a "ticket" received from the "hospital" girl. In either case, it represents a telephone out of service and for which some one is paying rent.

For this reason alone, it demands the most prompt attention. Again, as long as it is in trouble, no one can get that telephone and this brings about cause for many service complaints. It will thus be seen that it is even more to the interest of the company than the subscriber to get trouble cleared promptly. In a large office, each ticket passes successively through the hands of the complaint clerk, testing operator, wire chief's tester, trouble clerk, rack man, and, finally, the trouble shooter.

After trouble is cleared a report is made up at the end of each day, showing the number of cases of each kind cleared in order that an excess of any particular kind may be looked after. A record is kept of the amount of work done by each of the men engaged on trouble work, and the cost as well as the time in clearing is calculated.

In order not to delay the trouble tickets, it will be seen that perfect system must be employed, and the wire chief should see that all are thoroughly familiar with and are properly performing their duties.

In the proper maintenance of the office equipment, a great deal of trouble can be avoided and expense thus saved by looking out for details and instructing as well as watching the men. As an instance, a charging bill may be very much increased by a careless man in running a machine after batteries are charged; improper adjusting of relays will cause not only much trouble, but additional expense incurred by paying the men to do the work twice.

These points are mentioned to emphasize the necessity of watching out for details. It is the duty of a wire chief to keep such records as will catch these irregularities, and to take proper steps to eliminate them.

For the work of installing instruments, there is room for the exercise of the highest ability in instructing the men in the quickest manner of doing their work, in economizing in material used, and in doing work that will come up to specifications.

In order that the above work may be carried out expeditiously, it is necessary to keep in the central office an accurate record of all lines and wires leading into the exchange. This must be kept in such a manner that they are correct, easily changed and easily referred to, as it is necessary to go to the records for information for every case of trouble cleared and all work done by the installing force.

A wire chief should know exactly what it is costing him to maintain his plant; he should know the cost of clearing each case of trouble and what the ratio of trouble to subscribers is; the cost of installing each instrument and the amount of work done by each man.

To be exact, he should keep such records as will show the exact status and costs of all work performed and should take steps to keep costs as low as is consistent with good maintenance.

MODIFYING GOOD AND BAD WIRES WHEN LOCATING A TELEPHONE-CABLE FAULT.

BY W. G. MIDDLETON.

When a telephone-cable trouble is not cleared promptly, a wet spot will spread and dry out till each pair has a very slight ground on it of about the same resistance. This resistance may be from 100,000 ohms to several megohms.

The trouble should be cleared, however, as a second fault may appear at another location, producing a still worse situation to cope with.

A slight ground is a difficult fault to locate, especially if none of the wires are clear and no clear pair is available, either in another cable or among open wires to form the good pair of a loop test.

This outside good pair can go from one end of the faulty cable by a circuitous route if necessary. One of the good wires is used to complete the loop and the other to locate the far end of the bad wire, as in the Fisher method. But many times two clear wires are out of the question and the resistance of the fault is so high that the probable error of the overlap method, measuring from each end, would be too great. A high-resistance fault will often double in resistance or become almost as clear as a pair in a good cable from the voltmeter or bridge current applied.

Often ringing current on a wet pair will break it down by putting a cross or ground on it of a much lower resistance than the moisture produced. But, again, the ringing current may only clear the pair; in fact, this is generally the result.

It has been found that an automobile spark coil with its secondary wound for a voltage of about 500 volts is a wonderfully valuable adjunct to a cable-testing outfit. The spark has not the ability to strike through the paper insulation of a good pair from one wire to its mate. If there is a slightly moist place between the wires, this point can generally be broken down easily, with small danger of injuring the cable at any other point.

The lower the resistance of the fault the less strain is put on the dry or good portions of the faulty pair, as the fault, being of a lower resistance than the secondary of the coil, has only a fraction of the 500 volts across it. Therefore, a wire with a slight "short" on it is immune from danger, even from a 1,000-volt coil, giving a spark that would break down a clear pair.

It is found that the tone of the vibrator changes materially when the moist fault breaks down. The vibrator must then be stopped *instantly*, for the process may easily be carried too far and every vestige of the material composing the "short" may be destroyed. Then it will be difficult to short-circuit the cleared pair and another pair will have to be selected and the tone of the vibrator more closely watched, the battery wire being disconnected at the proper moment. The broken-down fault may clear itself automatically while being tested, but it can generally be brought back by a touch of the 500 volts from the spark coil. It is much easier to break through from one wire to its mate than from a wire to the sheath or ground, as the wire may not be in the outer layer of the cable and grounds on working pairs will be as attractive as the sheath. Also the induction of the spark coil will be less when breaking down a short-circuit, giving small annoyance to the subscribers connected by the cable.

This scheme is also valuable when erratic lightning burns are to be dealt with. Here the pairs are often the outside pairs and will be "dead" grounded one minute and perfectly clear the next. This is probably due to loose carbonized paper, which is changed in position by slight movements of the cable. If a small portion of the paper firmly touching the wire can be carbonized, or a chance connection established, a permanent ground may result.

These grounds and "shorts" may not remain for a current even as large as that given by the induction coil, but they are generally permanent for the current required for a loop test or for the overlap test. The electrical connection established by the spark coil is generally of a very low resistance, and loop tests may be made, using one of the pairs of the cable having the least ground and "short" on it, as the good pair. This is true because the bad wire has a "dead" ground on it and the slight ground, of say 200,000 ohms, on the good wire makes small difference in the result. Indeed, if necessary, a correction for this condition of affairs may be found in Kempe.

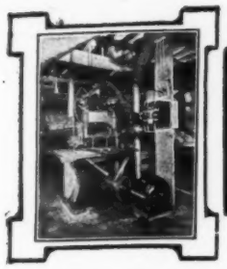
It will often be noticed when working on a terminal rack in a basement that a slight ground on the rack with a clear wire for the test will give a result showing the fault to be about 150 feet from the terminal rack. This result is the electrical average between the insulation resistance of the good pair and the slight ground on the bad wire. Here it will not do to break down the slight ground or cross, for this trouble must be cleared by drying out the silk and cotton forms on the rack.

With as many wires as there usually are in a telephone cable, one has an excellent chance to select wires suitable for the test or wires that can be made suitable. The good pair can often be "treated" and made almost perfectly clear, if necessary, by the application of direct current. Negative current has the property of making a ground more pronounced, while positive current will incase the wire with fine bubbles and insulate it, sometimes for several hours. It is often noticed when making a loop test on a slight ground that every application of the bridge battery makes the fault a little higher in resistance, and if care is not used in briefly tapping the battery key the ground will vanish before a balance is obtained. It will be found that if the battery is reversed, the conditions will change and the ground remain fairly constant so that a balance can be obtained.

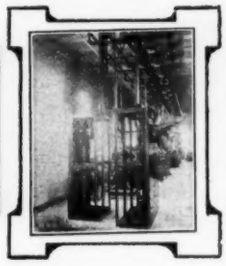
Continually applying a current will dissipate the moisture by changing it into gas. But if much water is present, this will not happen before copper salts have been produced that discolor the paper and give an increased ground. For this reason, for purposes of drying where there is considerable moisture, an alternating current should be used.

Therefore, a pair that is not too wet may be cleared and one not too dry may be broken down, which gives many opportunities for locating what would otherwise be difficult cases.

Exports of copper for the week ending Nov. 17, 9,551 tons; since the first of the month, 17,495 tons; last year, 14,897 tons.



Industrial Power



ELECTRIC POWER IN THE IRON AND STEEL INDUSTRY.—II.

BY J. J. ELINK SCHUURMAN.

Scherbius System of Regulation.—The first of these systems was brought forward by Dr. A. Scherbius. Instead of connecting a variable resistance to the slip rings of the induction motor, these are connected with a so-called "regulating motor," which is of the three-phase commutator type (see Fig. 2). Its purpose is to make use of the slip energy which was formerly lost in resistance, and to convert it into mechanical energy. It is generally shunt-excited, and is so wound that it possesses no inductance, and hence for all practical purposes can be regarded as operating as a continuous-current machine.

The speed regulation of the main induction motor is obtained in a simple manner by adjusting the excita-

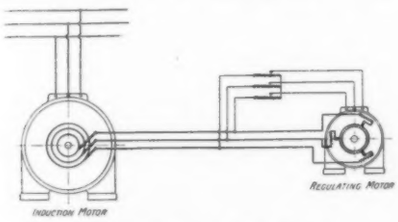


FIG. 2.—SCHERBIUS REGULATION.

tion of the commutator motor. As is well known, the slip of an induction motor is proportional to the rotor voltage. When the rotor voltage is forced by exterior means to increase, the speed will have to decrease. For a strong excitation of the regulating motor the speed of the main motor will consequently be low, whereas for weak excitation it will be in the neighborhood of synchronism. As the armature voltage of the regulating motor, which differs from the rotor voltage of the induction motor only to the extent of the ohmic drop in voltage, merely depends upon the excitation, the speed will remain constant from no load to full load. When a drop of speed is required between no load and full load, in order, for instance, to make use of the flywheel effect of the rotating masses, the regulating motor is provided with a compound exciting winding. As in the case of a continuous-current compound motor, the speed

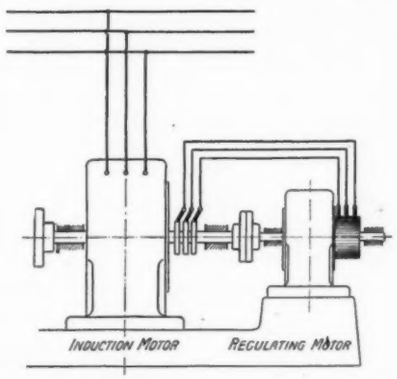


FIG. 3.—SCHERBIUS REGULATION WITH DIRECT-COUPLED REGULATING MOTOR.

will then drop from no load to full load over a certain adjustable range. Finally, a series excitation can be provided, which entails a form of regulation similar to that by resistance.

The question how the slip energy which the regulating motor converts into mechanical energy can be most favorably recovered can be solved in two different ways. In the first place, the regulating motor can be coupled mechanically to the main motor, so that the slip energy is given back to the main driving shaft (see Fig. 3). In the second place, the regulating motor can be coupled with a small induction generator. This regulating set converts the slip energy into electrical energy and returns it to the line (see Fig. 4). The first arrangement, in which the regulating motor is coupled directly or by means of a belt to the main motor, is in general the better one, as the available energy on the main shaft remains constant; that is, with decreasing speed the torque can be increased. In case of the arrangement with the regulating set only a constant torque is available (as in the case of regulation by resistance), so that the output must decrease with decreasing speed. Further, the total efficiency is more favorable in the case of mechanical coupling between the regulating motor and the shaft of the main motor. However, this arrangement is not always possible, as with it the regulating motor must follow the speed fluctuations of the main motor, and on this account becomes too expensive for very wide ranges of regulation. In such cases the regulating set, which runs at constant speed, is preferable.

A great advantage of the Scherbius regulating system lies in the possibility of extending the regulation above synchronous speed. The result is, that the regulating motor can be built smaller than is possible with regulation solely under synchronism. In or-

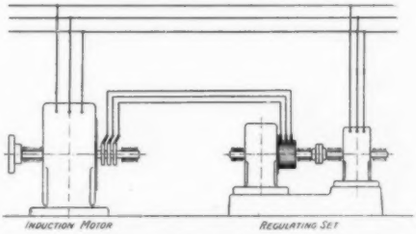


FIG. 4.—SCHERBIUS REGULATION WITH REGULATING SET.

der to obtain oversynchronous speeds it is only necessary to reverse the direction of the excitation of the regulating motor. The latter then runs no longer as a motor but as a generator. It does not take up slip energy, but, on the contrary, delivers slip energy to the main motor. The possibility of running above synchronism can also be of value for reaching very high speeds, as is sometimes necessary for rotary blowers, rotary compressors, etc. It should be realized that with a frequency of fifty cycles per second 3,000 revolutions per minute is the highest speed which can be obtained in the ordinary way, this being

the synchronous speed of a two-pole motor. The next lowest speed is 1,500 revolutions per minute for a four-pole motor. The advantage of being able to obtain intermediate speeds, and, above all, speeds over 3,000 revolutions per minute, is obvious. Such a degree of speed regulation has hitherto been unattainable with induction motors.

The Scherbius system also permits of compensating the phase difference between current and voltage of the main motor so that its power-factor becomes unity, independently of the load. By a small change in design, the regulating motor can be made to supply the magnetizing current necessary for the excitation of the main motor. The generators at the power station, and the transmission line, are then relieved from delivering this wattless current. If necessary, the regulating motor can also be designed to supply the excitation for other motors on the line, and thus will contribute still further to raise the power-factor of the entire system.

It has been mentioned that the regulating motor is of the three-phase commutator type. The simplest variable-speed three-phase motor would be such a commutator motor used directly as a main motor, if it could be constructed for the normal working conditions. However, certain difficulties with respect to good commutation stand in the way of building such motors. The higher the frequency and the larger the output, the greater are these difficulties. A commutator motor for several thousand horsepower, for instance, as often required in rolling mills, could not be built at the present time, although in the next few years considerable development may be made in this direction. The regulating motor described is connected to the rotor of an induction motor, in which the frequency is low, and, moreover, its output is small when compared with the output of the main motor. Again, the rotor voltage of an induction motor can be chosen at will within wide limits, even when the stator is directly connected to the high-voltage line, and thus the voltage of the regulating motor can be kept low, which still further facilitates its design.

The Scherbius system may be used for new installations, as well as in connection with induction motors which already exist.

Krämer System of Regulation.—A second system, designed to bring about an economical speed regulation of induction motors, is shown diagrammatically in Fig. 5, and is due to C. Krämer. The slip rings of the main motor are

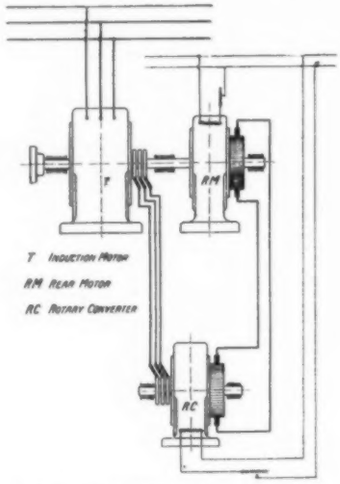


FIG. 5.—KRAMER REGULATION.

connected to a rotary converter, which changes the slip energy into continuous current. The latter is used to feed a continuous-current shunt motor, which is coupled mechanically to the induction motor and returns the slip energy to the main driving-shaft. The speed is regulated by varying the resistance in the shunt field of the auxiliary motor. When resistance is cut out, the armature voltage, and the continuous-current voltage of the rotary converter, will increase. At the same time the alternating-current voltage at the slip rings must increase, as the continuous-current and alternating-current voltage of a rotary converter stand in a fixed relation to each other. The speed of the main motor will thus decrease.

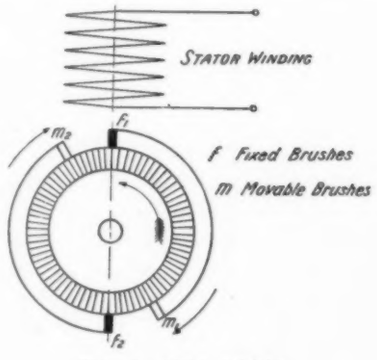


FIG. 6.—DERI MOTOR.

The speed of the rotary converter depends upon the rotor frequency of the main motor, and is proportional to the regulation. When the main motor runs at normal speed, the slip and rotor frequency are small, and the rotary converter turns very slowly; when the regulation is fifty per cent, the rotor frequency is fifty per cent of the line frequency, and the speed of the rotary converter increases proportionally. As the voltage at the slip rings should also increase in proportion to the regulation, and as in general voltage and speed are proportional values, it results that the design of the rotary converter is practically independent of the amount of speed reduction required. For this reason the Krämer system is very suitable for wide ranges of regulation.

The available output remains constant over the entire range of regulation, as the slip energy is returned to the main driving shaft.

The power-factor of the main motor may be improved to unity by adjusting the excitation of the rotary converter accordingly.

A disadvantage of the Krämer system, as compared with the Scherbius system, is its greater complication. More machines are necessary, and a special source of continuous-current energy is required for their excitation. Also, it cannot be so easily used in connection with existing motors.

Déri Motors.—The single-phase commutator motor of the Déri type offers a third solution to the problem of economical speed regulation. It comes into question especially for smaller outputs, and has the advantages of extreme simplicity and ease of regulation. This motor belongs to the repulsion-motor class, and its principle is shown in Fig. 6. For each pair of poles the motor has four brush holders, two of which are fixed and two movable. Each set of fixed brushes is connected electrically to a set of movable brushes. At rest, both are in line on the commutator in the pole middle. When the movable brushes are shifted to the right, the motor turns to the left, and *vice versa*. The result is that a reversal is possible without any switching over. The farther the movable brushes are shifted from the zero position, the more the torque increases. Normally the motor can start with two to two and a half times the normal torque and possesses a large overload

capacity. When required, it may be designed for still higher starting torques.

The stator and rotor are in no way connected, so that it is possible to keep the rotor voltage low. This seldom amounts to more than 100 volts at standstill, and decreases to ten volts and less when the motor is running. The result is great safety of operation; the brushes can without danger be renewed during running. As there is no connection between stator and rotor, the stator can be directly connected to high-tension circuits. The insulation is easy to effect, as the winding is simple and no intercrossing occurs. The rotor has a normal continuous-current winding without any complication.

The motor has a series characteristic, or more exactly, an infinite number of such characteristics, each being for a certain position of the brushes (see Fig. 7). It is consequently possible with any load, including running light, to adjust the brushes for any required speed. By moving back the brushes over the zero position during running, regenerative control can be obtained. The farther the brushes are moved back the stronger will be the braking action. The efficiency of regenerative control is similar to the efficiency of normal operation.

As said before, the great advantage of the Déri motor lies in its extreme simplicity: the entire regulation—starting, reversing, and adjusting of all speeds between standstill and ten per cent above synchronism—is effected merely by shifting the brushes. Beyond a two-pole stator switch no other switches, transformers, etc., are needed. In the case of smaller drives which require reversal, the Déri motor should be compared with an induction motor with starting resistance, controller, and reversing switch. The importance of the absence of all such apparatus is self-evident. Further, an absolutely continuous regulation is superior to regulation by means of controllers and resistances or regulating transformers, with which a great degree of subdivision is not possible.

When the output is small, the single-phase Déri motor will hardly affect the even distribution of the load on the three phases of the system, especially if there are several such motors which can be divided over the different phases. But when large motor outputs come into question, it is better to make use of a double-commutator motor, which electrically consists of two Déri motors, mechanically built into one (see Fig. 8). By a simple method of winding, such a double-commutator motor can be directly connected to a three-phase line, and exact measurements have proved that with it the load is quite as equally distributed over the different phases as in the case of a normal induction motor, while such a double-commutator motor retains all the good qualities of the Déri motor.

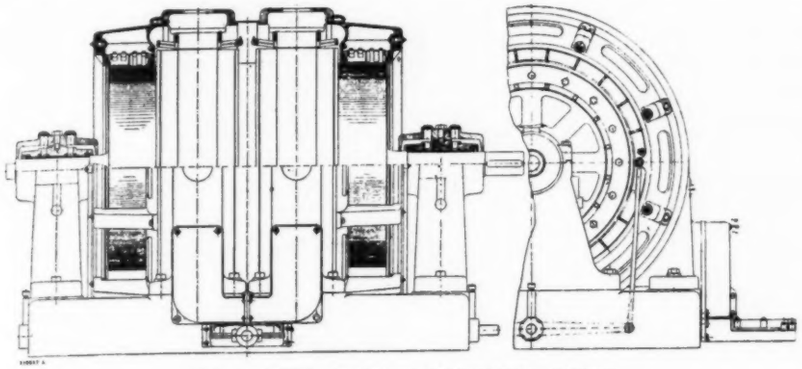


FIG. 8.—DERI DOUBLE-COMMUTATOR MOTOR.

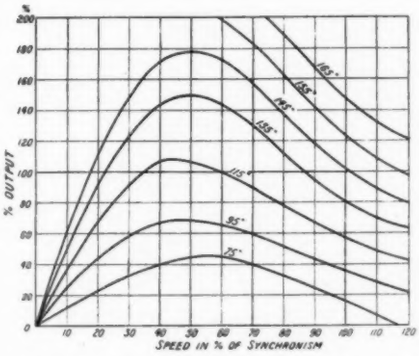


FIG. 7.—CHARACTERISTIC CURVES FOR THE DERI MOTOR.

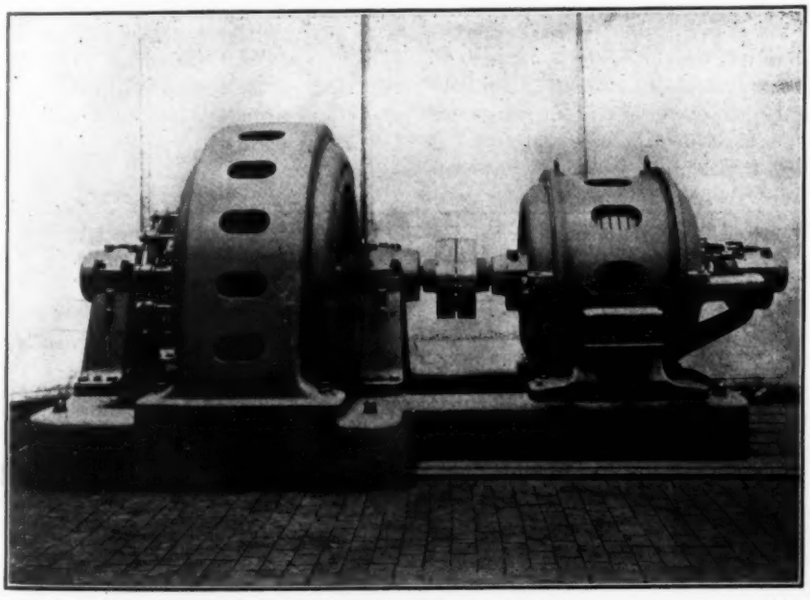


FIG. 9.—SCHERBIUS REGULATING SET.

Practical Applications.—Rolling-mill motors require large outputs, for which the induction motor is the most appropriate. For its regulation both the Scherbius and the Krämer systems are suitable.

At the Differdingen Steelworks (Luxemburg) a wire mill is in operation, driven by an induction motor of 2,000 horsepower and 150 revolutions per minute, which is regulated by means of a Scherbius regulating set of 240 kilovolt-amperes and 750 revolutions per minute. The latter produces a ten-per-cent drop of speed between

no load and full load. At the Deutscher Kaiser Steelworks, Bruckhausen, Germany, a bar mill is driven by an 1,800-horsepower induction motor for 375 revolutions per minute, fifty-per-cent regulation, and five-per-cent drop of speed between no load and full load. The Scherbius set is built for 400 kilovolt-amperes and 750 revolutions per minute (see Fig. 9). Several other installations are in course of construction. The Krämer system is also already in use in a few rolling mills.

When a new rolling mill is installed, it often cannot be determined beforehand what will be the most favorable speed for the process. In such a case it is advisable to design the driving motor with a sufficiently wide margin. Should its speed prove to be too high, one or other of the described systems of regulation permit of reducing it without affecting the efficiency of the installation or its power-factor, while apart from this speed reduction the driving motor can deliver the full output for which it was designed.

For small rolling mills of special type, such as plate-bending machines, corrugated-tube mills, etc., the Déri double-commutator motor does good service, on account of the technical advantages above referred to. For the Borsig Works in Upper Silesia, two double-commutator motors, each for 250 horsepower normal and 400 horsepower maximum output, are at present in course of construction for the operation of a corrugated-tube mill.

For the operation of blowers at variable speed, the Scherbius system with regulating set is often very useful. The arrangement with direct-coupled regulating motor is in this case less favorable because of the high speed of blowers. High speeds always entail certain technical difficulties for commutator machines. Moreover, the main advantage of the direct-coupled regulating motor, *viz.*, to keep the output constant, is of no value with blowers, fans, and similar machines, for which the required output greatly decreases with decreasing speed.

The Déri motor, either as single or as double-commutator motor, is very suitable for most of the auxiliary drives in steel mills, which require regulation.

In the first place, the drive of those live rollers which require constant reversing must be mentioned. Their starting conditions are severe because of the acceleration of all the moving parts. To this class of service the Déri motor, with its high-starting torque is well adapted.

For the operation of blast-furnace hoists the Déri motor is to be preferred to the induction motor on account of its smooth acceleration and the smaller current peaks which it produces, while again it permits of an entirely automatic operation.

Conclusion.—It has been shown that economical speed regulation for alternating-current motors, both of large and small output, may nowadays be obtained. It has also been explained that the inherently low power-factor of iron and steelworks installations can be greatly improved, when one or more induction motors of the plant are arranged for speed regulation according to the Scherbius or Krämer systems before described.

Owing to these improvements, the three-phase system of current distribution will more than ever meet the requirements of an economical utilization of the blast-furnace gases.

The energy available in these gases furnishes a large source of power. It must be borne in mind that from the gases arising from the production of one ton of pig iron, a gas-engine power station will develop 400 kilowatt-hours, when it is assumed that sixty per cent of the total gas production is consumed by the blast furnaces themselves. The utilization of this source of power is of the greatest importance for an economical production.

Also from the standpoint of national economy this question is of vital interest, as it is closely connected with the conservation of the country's coal supply. With the annual production of pig iron amounting to 10,000,000 tons, the use of the waste gases permits of a saving of 2,500,000 tons of good coal. This saving becomes possible only through the centralization of the power production and the distribution of energy by means of electrical transmission, and nowadays it can be utilized to the utmost by such means with the help of the efficient motor drives referred to in this paper.

Electric Drive for Locomotive Works.

The American Locomotive Works, Pittsburg, Pa., will shortly erect a new power plant for the shops on the lower North Side.

Electric Smelting in Norway.

Consul P. Emerson Taylor, of Stavanger, Norway, reports that the Norwegian Electrometallurgical Commission has completed its work and filed its report. In speaking of the work of the Commission, Professor Farups, of the University of Christiania, one of the members, says:

"It is quite possible for us, in electric smelting of iron ore, to compete with smelting ovens of the old type in other countries. The iron ore is no more expensive here than in other places, and Norway is richer in electric energy, and electric power here is much cheaper than in other countries. Besides, we have very good export seaports, with our waterfalls and electric power close to the sea. Should the electric smelting of iron and steel, in spite of all this, become more expensive than smelting by the old methods, it will still be able to compete with the old method of smelting because of the much finer quality of the product. In Sweden, where the new electric smelting ovens have been installed, the results show that the new method is a success and in an advanced stage of progress, and Norway will, with her electric power and transportation facilities, have many advantages over Sweden."

Copper-Graphite Brushes.

The Commonwealth Edison Company, Chicago, Ill., has adopted a composite brush, consisting of copper and graphite, on some of its new 1,000-kilowatt rotaries. There are forty-eight brushes on each machine, each with a face area of 1.875 square inches. Under a full-load current of 2,000 amperes per phase the current density is about 133 amperes per square inch, or twice that used with the copper brushes.

Electric Drive in Salt Making.

At the Haverton Hill Wells of the Salt Union, Ltd., the great English salt-manufacturing trust, electric power is being adopted to replace other forms of drive for brine pumping and salt making.

Turkeys for Electric Employees.

Following its custom for the past few years, the North Shore Electric Company, Chicago, Ill., will give a Christmas turkey to each of its employees who shall have completed at least one year in the Company's service by December 25, 1910.

The King City (Mo.) Electric Light & Power Company will shortly install a sixty-horsepower producer-gas engine together with various additional electrical apparatus for the enlargements to its power-house equipment.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

KINGS COUNTY ELECTRIC LIGHT AND POWER.

The report of the Kings County Electric Light and Power Company, including the Edison Electric Illuminating Company, of Brooklyn, for the month of October and ten months ended October 31, 1910, compares as follows:

	1910	1909
October gross	$ 355,238	$ 299,977
Expenses	172,712	159,638
October net	182,526	140,339
Charges and depreciation	112,790	87,260
October surplus	69,736	53,079
Ten months' gross	3,501,741	3,020,598
Expenses	1,692,528	1,493,307
Ten months' net	1,809,213	1,527,291
Charges and depreciation	1,046,254	877,170
Ten months' surplus	762,959	650,121

UNITED GAS AND ELECTRIC.

The earnings of the United Gas and Electric Company, of Philadelphia, for the year ending September 30, 1910, as furnished by Bertron, Griscom & Jenks, are as follows:

	1910	1909
Surplus from subsidiary companies	$ 484,295	$ 367,638
Other income	57,035	70,162
Total income	541,330	427,800
Fixed charges	91,075	91,075
Net surplus	450,255	336,725
Preferred stock dividends	58,605	58,605
Amortization	76,826	17,461
Surplus	314,824	260,659

SYRACUSE RAPID TRANSIT.

The report of the Syracuse Rapid Transit Railway Company for the quarter ended September 30, 1910, compares as follows:

	1910	1909
Total operating revenue	$ 409,557	$ 371,869
Total operating expenses	278,852	292,014
Net operating revenue	130,705	79,855
Taxes accrued	17,607	18,719
Operating income	113,098	61,136
Non-operating income	131	137
Gross income	113,229	61,273
Total deductions from gross income	78,883	76,323
Net corporate income	34,345	*15,051

*Deficit.

AMERICAN LIGHT AND TRACTION.

The report of the American Light and Traction Company for the month of October and ten months ended October 31, compares as follows:

	1910	1909
October gross	$ 356,685	$ 313,847
Expenses	11,126	8,865
October net	345,559	304,982
Ten months' gross	3,009,842	2,619,970
Expenses	100,550	88,055
Ten months' net	2,909,292	2,531,914

The report of the American Light and Traction Company for October shows an increase of 13.3 per cent in net over last year. Two subsidiary companies that send in their monthly earnings did not show the gains which the officers of the American Light and Traction Company expected, and an investigation has been ordered to ascertain why a better showing was not made. An increase of 13.3 per cent in October's net brings the rate of increase for the first ten months of the year down to fourteen per cent. At this rate the net for the year will be $3,721,817, which is equivalent to 27.72 per cent on $10,345,000 common stock after preferred dividends.

INTERBOROUGH RAPID TRANSIT.

The New York Public Service Commission has issued a report of the Interborough Rapid Transit Company (including both divisions) for the quarter ended June 30, 1910, which compares as follows:

	1910.	1909.
Gross	$7,457,567	$6,999,041
Expenses and taxes	3,279,230	3,111,079
Net	4,178,337	3,887,962
Other income	90,967	252,240
Total income	4,269,304	4,140,202
Charges	2,640,244	2,600,053
Surplus	1,629,060	1,540,149

FT. WAYNE & WABASH VALLEY.

The report of the Fort Wayne & Wabash Valley Traction Company for the month of August and eight months ended August 31, compares as follows:

	1910	1909
August gross	$140,625	$133,412
Expenses	73,926	74,255
August net	66,698	59,157
Charges and taxes	45,845	45,112
August surplus	20,854	14,045
Eight months' gross	998,040	905,613
Expenses	563,417	537,475
Eight months' net	434,623	368,139
Charges and taxes	360,441	338,773
Eight months' surplus	74,182	29,365

AMERICAN TRACTION.

The annual report of the American Light and Traction Company for the twelve months ended September 30, 1910, shows net earnings of $3,575,980, against $3,089,190 in the previous year. Following is the income account, with comparisons:

	1910.	1909.
Net earnings	$3,575,980	$3,089,190
Preferred dividends	854,172	854,172
Common dividends	926,701	740,353
Surplus	1,795,101	1,494,665
Previous surplus	5,622,683	5,184,027
Total surplus	7,417,784	6,678,692
Stock dividends, common	973,530	1,056,010
P. & L. surplus Sept. 30	6,444,254	5,622,683

LAKE SHORE ELECTRIC.

The report of the Lake Shore Electric Railway Company for the month of September and nine months ended September 30, 1910, compares as follows:

	1910.	1909.
September gross	$115,009	$108,207
Expenses	54,417	49,842
September net	60,592	58,365
Charges	34,928	34,804
September surplus	25,664	23,560
Nine months gross	913,664	835,061
Expenses	473,160	439,691
Nine months net	440,504	395,370
Charges	313,008	309,093
Nine months surplus	127,495	86,277

CONSOLIDATED GAS OF BALTIMORE.

The Consolidated Gas, Electric Light and Power Company, of Baltimore, has issued a report of the year ended June 30, 1910. The income account compares as follows:

	1910	1909
Gross earnings	$4,699,098	$4,449,276
Expenses and taxes	2,265,534	2,279,578
Net earnings	2,433,564	2,169,698
Fixed charges	1,374,362	1,383,164
Net income	1,059,202	786,534
Preferred dividends	423,603	423,603
Balance	635,599	362,931
Common dividends	126,001	.....
Surplus	509,598	362,931
Reserve for renewals, am., cont., etc.	275,596	.....
Profit and loss surplus	252,002	362,931

Western Electric Business for 1910.

The Western Electric Company's fiscal year ends with the current month, but the Company's report will probably cover thirteen months in order to make the fiscal year hereafter correspond with the calendar year. October returns, gross, were forty per cent larger than last October, and the twelve months, ending November, will show gross sales of over $61,000,000

Speaking of the improved showing which this year will show over last an officer of the Company said:

"The increase in the business is well distributed over the various classes of merchandise that the company handles and well distributed throughout the eighteen houses which represent the Company in the United States.

"In telephone apparatus and cable business the increase has been gratifying and new uses to which the telephone is being put in connection with forest fire protection, railroad train dispatching and in the household and in the factory are constantly adding to the demands upon the Company for an increased output."

The Western Electric has now disposed of the greater part of its Chicago surplus real estate, which consisted of its Polk Street and Clinton Street property. Nearly $4,000,000, which was received for the property, will be added to its already large working capital. Recently the Company appropriated $1,000,000 for new buildings at Hawthorne, and doubtless before the present lease expires on the 500,000 square feet of the Clinton Street property which the Company still occupies, it will be necessary to erect further new buildings at Hawthorne to carry out the policy of concentration now in effect. The Company is employing 24,000 men.—*Wall Street Journal.*

Copper Exports for October.

Total exports of copper for October were 27,917 tons, against 23,876 in October, 1909.

New Electrical and Mechanical Apparatus and Appliances.

A New Relay.

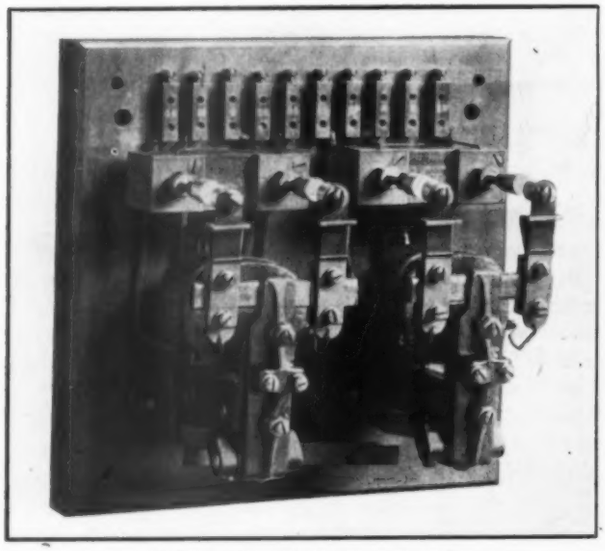
The Westinghouse Electric and Manufacturing Company has just brought out an entirely new design of the secondary or auxiliary relay for its induction regulators. The new relay embodies several features that have been found desirable in this class of apparatus by the Westinghouse Company. These features, it is claimed, insure excellent performance and long life.

The new relay is of the dry type, while the former was oil-immersed. The non-inductive resistance that was used in the old-style relay is used with the new style, but is now built as a primary part of the relay instead. This resistance, permanently connected across the contacts, absorbs the inductive discharge of the coils at the moment of breaking of contact, and assists in the elimination of sparking.

As all the wearing parts used in the new relay are case-hardened it is very durable. In fact, the relay has been designed as a continually operating, hard-service mechanism instead of as an instrument. The use of nickel for the relay contacts is a marked advancement, as it gives all the advantages of platinum, at a cost for renewals that is negligible. The results obtained from the operation of motor-operated regulators by means of this relay have been very satisfactory. The wear on the contacts is so slight that the adjustment and renewal of contacts is reduced to a minimum. When necessary, however, this adjustment or renewal can be very easily effected.

A feeder regulator will pay its cost in a short time by maintaining the voltage at a constant point. Close voltage regulation causes a decrease of lamp renewals, an increase in the sale of energy, an increased feeder capacity, and a higher economy of operation of the system; it helps greatly in making the customers satisfied with the service.

Central-station managers now fully appreciate the economy to be effected by use of feeder regulators, and are rapidly taking them up. Formerly some mechanical troubles have been encountered in these, but, in their present state, feeder regulators are said to be practically as reliable as the static transformer.



NEW WESTINGHOUSE RELAY.

RELAY WITH COVER ON.

Students Make Annual Inspection Trip.

Practically the entire senior class of electrical engineering students of the University of Illinois was in Chicago on November 21 inspecting the generating and substations of the Commonwealth Edison Company.

The occasion was the annual inspection tour of the students, which covered, in addition to the Chicago plants, the shops of the Allis-Chalmers Company at Milwaukee and the steel works at Gary, Ind.

A New Vehicle Storage Battery.

At the first convention of The Electric Vehicle Association of America, held in Madison Square Garden, New York, on October 18, the Electric Storage Battery Company, of Philadelphia, manufacturers of the "Exide" battery, announced that it had perfected a new vehicle battery, which, with greatly increased capacity, would have two to three times the life of the present type. After a long tryout under conditions much more severe than would be met with in everyday practice, with results far beyond the most sanguine expectations, the new battery is now about to be put on the market.

What vast possibilities this new development of the lead storage battery opens up to the electric-vehicle industry at large and the user in particular, can scarcely be appreciated but by one familiar with the art. The time is not far distant when the average city dweller will be enabled to maintain his electric runabout for such a trifling sum per annum that its use will become as much a general necessity as the electric light or the telephone.

It is estimated that, owing to the enormous business which the Westinghouse companies have been doing for some months, the employees of the companies received over $2,500,000 as salary and dividends during October.

Garwood Electric System for Driving Newspaper Presses.

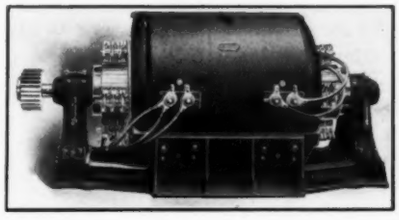
During the past ten years the method of operation and control of printing presses has received a large amount of attention and the electric drive, as in many other fields, has become one of the most important factors in the refinements of modern printing establishments.

The Garwood Electric Company, Garwood, N. J., having acquired the patents of the C & C Electric Company, which latter company had for many years manufactured a lever system of electric control for printing presses, decided to supplant this system with a station-control system, which would embody all of the advantages and have a number of features not found in other systems of control.

The component parts of the station-control system consist of a motor and base plate, switchboard and control stations. The motor is of the protected type and is of rugged construction. The armature coils are large and are liberally insulated. But a single set of spur gears is used. The shaft is of liberal diameter, the magnetic frame is split horizontally, permitting easy removal of the top half of the same, while the removable bearings are of the pedestal type, with separate caps and split bushings. All parts are readily accessible in the limited space in the motor pit.

The motor and its two pedestal bearings are mounted on a substantial bed plate, which is accurately machined, and assures the perfect alinement which is necessary in gear drives.

The brush rigging and brush holders are rigidly designed to prevent vibration being transmitted to these parts by the gear. The motor is of the commutated pole type, designed especially for printing-press work, and developing the heavy torque required for starting.



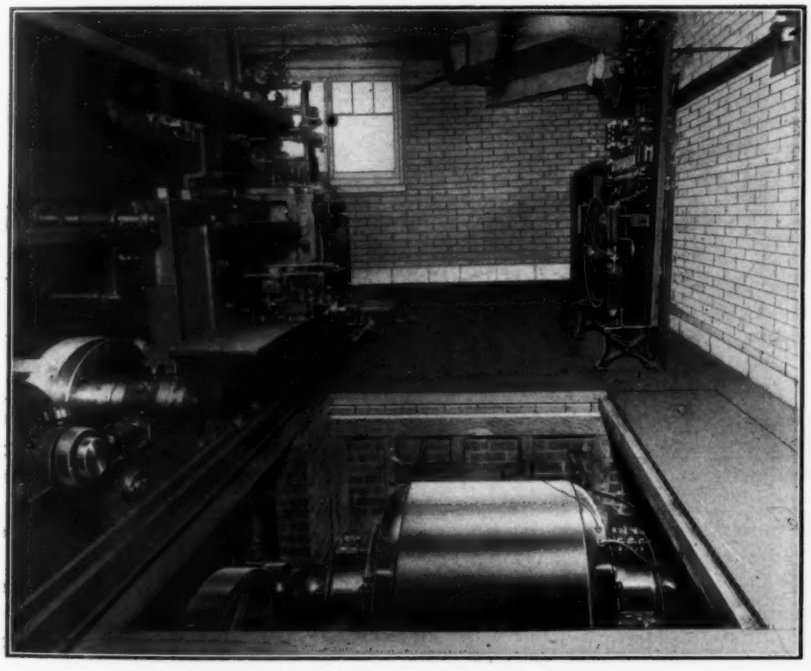
MOTOR.

The switchboard is of black-enameled slate, approximately forty inches wide by eighty-four inches high, on which is mounted the following apparatus:

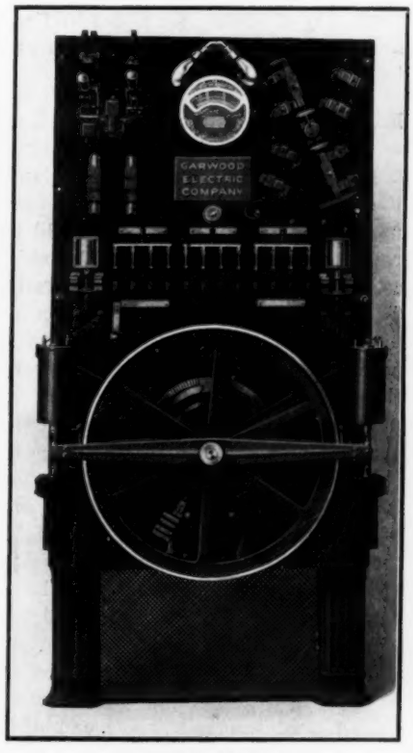
One automatic switch for opening and closing circuit; one Weston amperemeter; two pilot lights; one double-pole knife switch; one circuit-breaker for protection of motor and press at high and intermediate speeds; one circuit-breaker for protection of motor and press at slow speed; one automatic controller and hand wheel having approximately 100 field contacts and returning to zero whenever press has been stopped; one emergency stop button for use with hand control; three knife switches and necessary field and starting resistance.

The control stations of these systems are of substantial construction and are comprised of three buttons, *A*, *B* and *C*. "A" is the starting, accelerating and safety button for starting and increasing the speed of the press. It is equipped with a safety device for locking the press against any further increase in speed until released at the station at which it was applied, but allowing same to be slowed down to ten revolutions of the cylinders or to be stopped from any station while the press is at safety. "B" is the slowing-down button for decreasing the speed of the press from maximum to ten revolutions of the cylinders. "C" is the stop and lock button for stopping and locking the press simultaneously and holding the same locked until locking device has been released at the station at which it was applied.

In the event of any disarrangement of the wires of the press-control station, the equipment may be operated perfectly either from the head pressman's control station or by hand. An emergency button is provided for quick stopping in connection with hand control.



INSTALLATION OF COMPLETE GARWOOD EQUIPMENT.



SWITCHBOARD.

The system is foolproof. Should more than one pressman push the "slow-down" button, the equipment would slow down. Should one pressman push the speed button, while another simultaneously pushed the "slow-down" button, the press would slow down at once.

Pressing the "stop" button not only stops the press, but locks it at every station until the automatic catch on the stop button is released at the station where it was applied, making it absolutely safe for any pressman, by merely stopping the press, to go under same without danger. No current is in the fields of the motor or in any part of the system when the motor is not in operation, the field of this patented type of motor being broken when the motor is still in operation.

Other advantages claimed by the manufacturers are: Low starting current (less than twenty per cent of full-load current); positive and constant intermediate speeds at all points of the speed range; making and breaking of all contacts of the control station in oil; no sparking at controller contacts and the possibility of setting the high speed and low speed circuit-breakers close to actual load.

Electric-Design Opportunities in Textile Work.

During a recent lecture in England, Frank Nasmith said: "There are many textile machines which could be rendered very much more efficient if certain parts were operated electrically. Take, for instance, the operation of picking or the propulsion of the shuttle across the loom between the warp threads. The amount of power expended is out of all proportion to the actual power required for the purpose. Not only is this the case, but the action is nonpositive, the shuttle being out of control for at least one-half of its travel. I am of opinion that means can be found to utilize electrical devices which will positively propel the shuttle across the loom. To take another side of the industry, *viz.*, calico printing: In many machines a number of engraved rollers are employed which for certain predetermined periods are held out of contact with the fabric, and then for other periods are brought into contact to produce the required pattern. An ingenious invention, patented a few years ago, employed hydraulic rams, the valves being operated by a pattern chain."

THE DEVELOPMENT OF PROTECTIVE DEVICES FOR HIGH-TENSION CIRCUITS.

BY P. G. LANGLEY.

The past decade has witnessed a growth of electrical development which far surpasses the progress in any other industrial line. It was shown at an early date that the simplest, safest, most efficient and, therefore, the cheapest method of utilizing power, was to be found in the use of electricity as the converting agent.

Electricity is most economically generated near a source of power, whether water, gas or coal. This fact has led to the development of many power sources, some of them remote from localities where there was a demand for power.

FIG. 1.—COMBINED FUSE AND DISCONNECTING SWITCH.

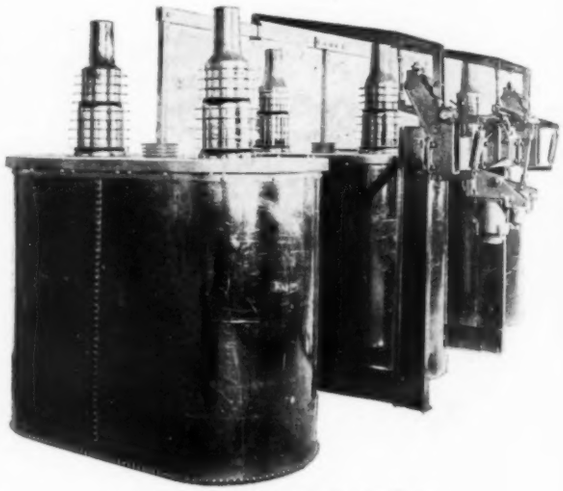


FIG. 2.—110,000-VOLT OIL SWITCH.

Locations close to centers of demand were first developed, and as the distances over which power was to be transmitted were small, few serious difficulties were encountered in the early days. As the nearer powers were developed, the increased demand created necessitated the development of the more remote powers. Then arose engineering problems which have forced the development of apparatus to handle the high voltages necessary for economical transmission over long distances. One of the first long steps toward high-voltage transmission was made about eight years ago, by the Washington Water Power Company. This Company, in order to supply power to the mines of Washington and Idaho, over transmission lines about 150 miles long, decided to use 60,000 volts. This development proved so successful that it was speedily followed by others and by rapid rises in voltage until 110,000 volts is now by no means unusual, and a rise to 140,000 volts has been proposed.

To meet these conditions it has been necessary to develop switching, measuring and protective equipment along radically new lines.

High-voltage developments are necessarily expensive, and to effect economy large powers must be employed, so that in addition to taking care of high-potential strains, it has been necessary to produce equipments capable of withstanding the explosive effect of interrupting the flow of large amounts of energy.

The first high-voltage switches were designed along the lines of previous switches for lower voltages, the spacing and insulation being increased in proportion to the voltage. These consisted of contacts working in separate inclosing chambers, partly filled with oil, in which the arc was finally broken.

For each line wire two breaks in series and, consequently, two chambers were employed, each pair of chambers being installed in an isolating, fireproof compartment.

The chambers were later improved by the addition of baffle plates and expansion chambers, which prevented disruption of the oil, splashing of oil out of the pots, and allowed space for the safe expansion of gases formed by arcs.

To increase the rupturing capacity,

these switches are provided with explosion chambers surrounding the contacts. These confine the oil and force it at high pressure between the contacts at the point at which the arc is ruptured. The explosion chambers being entirely submerged in a larger volume of oil, any oil forced out by the expansion of gases is immediately and automatically replaced.

These switches are usually electrically operated and located at some distance from the point of control, but they have also been designed for hand operation. They are limited to systems of not over 60,000 volts. These switches, which are suitable for large power installations, are expensive, and to meet the condition where a small amount of power was to be tapped from a transmission line, some simpler protective device had to be provided.

This problem was solved by the introduction of the expulsion type fuse, shown in Fig. 1. This fuse, mounted in a suitable holder, which acts as a disconnecting switch for the circuit, permits opening the charging current of a line or the magnetizing current of a transformer, at the same time disconnecting the fuse holder from the circuit so that a fuse can be easily and safely removed or replaced.

These fuses, under proper conditions, furnish excellent protection for lines and apparatus, as, due to their property of generating a high pressure at the rupturing point of the fuse, and their quick action, the circuit is opened with little, if any, more disturbance than where an oil switch is used. There are, however, a number of engineering features which should be carefully considered before deciding upon fuses.

To meet the demand for a moderate capacity, reliable switch which could be installed at a less cost than the large capacity switch, a new type of oil switch has been designed.

In this switch, which is shown in Fig. 2, each pole, consisting of two breaks in series, is assembled in a separate iron tank of large dimensions. The three poles necessary for a three-phase circuit are operated as a unit by one mechanism, either by means of a hand-operated lever, by air or by solenoids electrically operated from the central board.

FIG. 3.—110,000-VOLT OIL SWITCH.

This switch does not require isolating cells for the oil tanks, these being simply set up on the station floor, the spacing and size being varied according to voltage, the limit of which is 110,000 volts.

High-capacity oil switches have been designed along the lines of the one last mentioned, which are capable of handling the largest powers yet developed at any voltage considered up to the present time. A view of one of these is shown in Fig. 3.

In order to provide the necessary insulation between live parts to take care of the higher voltages, spacings and break distances have been increased. The oil tanks are larger and contain a greater volume of oil.

These switches, being top connected, admit of a very simple and flexible station layout. All wiring being overhead, station buildings do not require basements, and can, therefore, be constructed more cheaply than when bottom-connected switches are used. The absence of cell work and barriers also tends to greatly reduce the cost of installation.

In order to provide automatic protection for apparatus under abnormal conditions of overload or short circuits, two schemes are now in general use. The first, and oldest, employs series transformers, the primaries of which are connected in the high-voltage circuit to be protected. The secondary winding, suitably insulated from the primary, is connected either direct or through suitable relays to the coil which attracts the tripping mechanism of the switch controlling the circuit.

The second uses relays, thoroughly insulated from the ground, the solenoids of which are connected directly in the main circuit. These operate the tripping mechanism of the switch either directly by means of insulating rods or by means of an auxiliary source of power and a trip coil on the switch mechanism. These relays are designed only as single-pole units, one of which is connected in each line wire, and are not suitable for conditions which require the bringing together of two high-voltage circuits in one unit.

Where wattmeters or watt-hour meters are required series transformers are necessary and can be used to operate protective devices in addition to carrying the instrument load.

A very satisfactory indicating device for use on high-voltage circuits is formed by mounting a standard am-

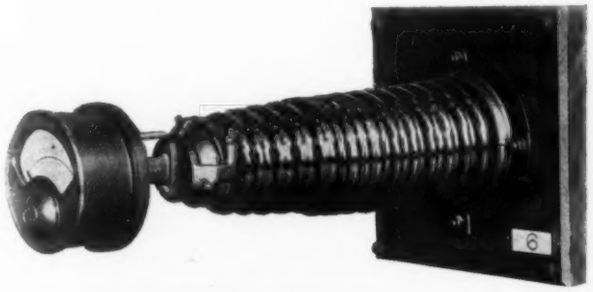


FIG. 4.—AMMETER MOUNTED ON POST INSULATOR.

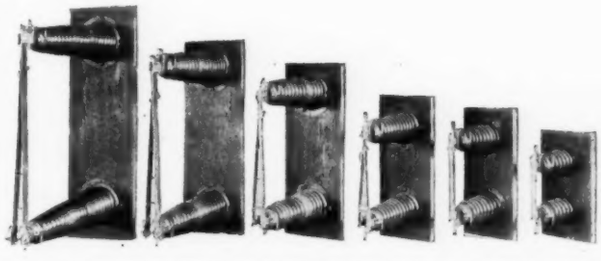


FIG. 5.—DISCONNECTING SWITCHES FOR 22,000 TO 110,000 VOLTS.

meter on a suitable insulator to prevent leakage to ground. These instruments are connected directly in the main circuits, and should be so mounted that accidental contact with them by the station attendant is impossible. These instruments are used in those installations which lend themselves to the use of series relays, and together they form a very compact and cheap equipment. A view of one of these equipments is shown in Fig. 4.

Disconnecting switches of various forms are in general use on high-voltage circuits. These, as a rule, are not intended to open a power circuit, but can be depended upon to open the magnetizing current of a transformer or charging current of a line. Fig. 5 is a view of disconnecting switches for voltages ranging from 22,000 to 110,000 volts.

The well-known knife-blade type is widely used, the spacing and break distances being proportioned to the voltage. These switches are invaluable for isolating stations or apparatus in stations at times when it is necessary to do work on the apparatus without shutting down an entire system.

Switches capable of opening a moderate amount of power have been perfected for outdoor use. These are mounted on a pole or tower structure and may be operated from the ground by means of a suitable mechanism.

The final breaking of the arc is accomplished on metal horns, which, bending upward and outward, allow the arc to follow its natural course upward and to rupture itself at the ends of the horns.

The most difficult problem in high-voltage development and one on which the success of any power transmission scheme depends, has been the production of suitable insulation for the lines.

As the lines are exposed to all weather conditons, traverse long stretches of exposed country, and are compelled to make numerous bends and to follow the natural grades, it has been necessary to produce insulators to meet any and all service conditions.

With the old-style pin insulator construction line voltages were limited to about 60,000 volts, due to the great weight of the insulators for higher voltages and the high cost of towers, which had to be erected at close intervals.

Higher-voltage transmission has been made possible by the introduction of a new insulator, known as the link type. These are made in two forms, one known as the suspension type and the other as the strain type.

Each complete insulator consists of a number of porcelain units joined together by suitable links, the number of units in series being varied in proportion to the line voltage.

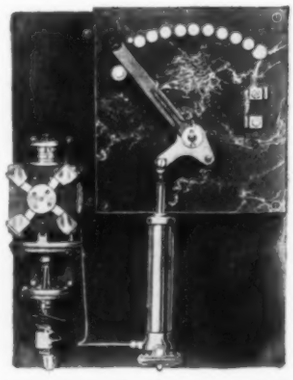
Using these insulators it has been possible to greatly increase the distances between supports

A New Automatic Controller.

A new electric controller that will be

AUTOMATIC SWITCH.

of interest to the electrical trade in general is now on the market, after having undergone several years of severe tests in the plant of its manufacturers and on numerous installations in which it has been used.



COMBINED SWITCH AND RHEOSTAT.

This controller, known as the Perry, has several new and distinctive features that heretofore have not been incorporated in a device of this kind, for, besides the primary purpose of throwing on and off a switch, it may be used in many places where it is advantageous to transform variations of pressure into a mechanical action. It is not confined to operation by air pressure, but may also be used with liquid pressure, making it available for service with stand pipes and compression tanks operating on any current—direct or alternating—and single or polyphase motors. The Perry controller is entirely unlike any other, in construction as well as in action. It is small and compact, easily adjustable, may be set to operate at any tension, and is adjustable to cut in and cut out on as small a variation as five pounds.

This sensitiveness is not attained at a sacrifice of power or positiveness. It makes or breaks circuit with the same force at small variations and low reservoir tension as with high pressure and great variations. The action of the contact arms is instantaneous, making the necessary snap break of circuit. The contacts are of the wiping variety, with ample area.

A combination switch and rheostat controller is also made for larger motors. In this device the switch is operated as described and a valve is added which admits the full pressure of air or liquid to a piston, which in turn operates the rheostat lever. The action of the piston is adjustable, which allows the proper regulation of speed of the rheostat lever.

The variation diaphragm plays no part but to operate two small valves, which admit air to the upper diaphragm operating the mechanical head. The air pressure is counterbalanced by an adjustable spring, which is set according to the "cut-out" pressure desired. A variation nut and set screw regulates the variation between cut-out and cut-in tensions.

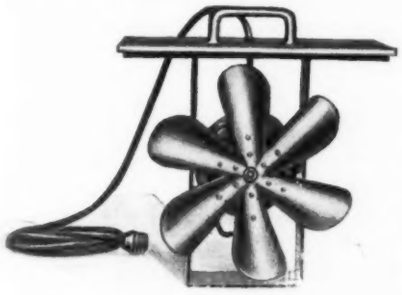
A decidedly new feature in the Perry controller is the method of developing dynamic force from static pressure, producing a mechanical movement in a form adaptable for the shifting of belts, turning of valves and like duties. With it an air compressor belted to line shafting may be automatically started and stopped by the variation of pressure in the reservoir. A pumping plant may be made to operate according to changes in water level in a stand pipe. Predetermined tensions may be maintained in compression tanks by direct manipulation of electric current, or by shifting of belts operated by any other motive power.

The uses of this new controller are many. From a device originally con-

structed for the simple throwing of a switch for small motors, there has developed a mechanism capable of handling, by rheostat, the largest of motors, and a device that is proving of great service in a field of its own making—the automatic control of electric current and the regulation of compressing and pumping plants with other motive power by a slight variation of air or liquid pressure. The controller is being placed on the market by the United Pump and Power Company, 469 Old Colony Building, Chicago.

Exhaust-Fan Blowers for Furnaces.

At this time of the year when furnaces are being started, the subject of



EXHAUST FAN BLOWER.

a good circulation of fresh air through the heating system and the rooms of a building is one which is receiving a great deal of attention. Fresh air is more essential to good health than heat, and a good heating system must provide for the circulation of fresh air. Of the many schemes advanced the most practical seems to be a fan blower placed in the cold air box.

The Western Electric Company has just added to its list of well known "Hawthorn" motors a line of exhaust-fan blowers. This device consists of a moderate-speed motor driving a six-blade fan and mounted on a supporting frame attached to a cast-iron cover plate. This cover plate is provided with a lifting handle, by means of which the blower can be easily removed from the cold-air box if desired. No starting box or auxiliary equipment is necessary. A ten-foot lamp cord and socket is provided and connection can be made with any lamp socket. The motor requires no attention whatever, is of simple construction and reliable.

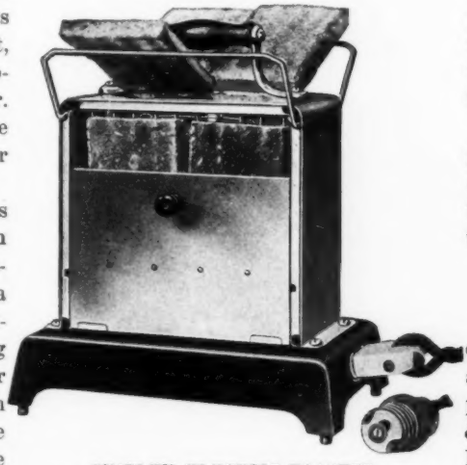
These exhaust fan motor blowers are made to operate on both 110 and 220-volt direct current, and 110 and 220-volt single-phase alternating current.

New Features of the Simplex Toaster.

The suitability of a household electrical device as a Christmas present was well evidenced by the enormous demand made upon the manufacturers of electric flat irons, toasters, coffee percolators, chafing dishes and other heating and cooking devices last year. It is predicted that these devices will solve the Christmas-gift problem to an even greater extent this year, and anticipating this many manufacturers are making preparation for an "Electrical Christmas."

In this connection attention is called to the line of Simplex Electric Heating Company, Cambridge, Mass., which includes toasters, household irons, water cups, travellers' stoves, milk warmers, and heating pads. All of these devices will be packed in holly boxes for the Christmas trade.

Of especial interest are the new features of the electric toaster which make it an ideal gift. The improvement provides a toast rack on top of the toaster that consists of two wire supports that project upwards at an angle of about forty-five degrees from either side, coming out of the top of the toasters. These provide supporting bars to rest toast on, the other end of the toast resting on the top of the frame. It in



SIMPLEX ELECTRIC TOASTER.

no manner interferes in operating the toaster, but places the toast directly over the hot air rising from within, keeping it warm or drying fresh bread while other toast is in the making. When the toasting is over they drop out of sight. A view of a Simplex toaster with the new "Keep-Hot Rack" is shown in the accompanying illustration.

The Ellis Time Stamp.

In any business where a record of time is of any consequence the time stamp is an indispensable factor. In the accompanying illustration is shown the Ellis stamp, which owing to its ingenious construction, its simplicity and durability is adapted to all conditions and uses.

The device illustrated is manufactured by the Ellis Time Stamp Company, 85 Fifth Avenue, Chicago. It consists of a special watch movement set in a nickel-plated case and adjusted

ELLIS TIME STAMP.

in such a manner as to reduce the wear to a minimum. It is stem winding and stem setting. On the lower side is a printing dial, in the center of which the hour and minute hands revolve automatically and simultaneously with the hands of the watch.

The hands within the printing dial placed in juxtaposition to the hands on the face show the exact time, and the date line, immediately below, shows the day when the impression is taken.

Large Order for Motors.

One of the largest orders for small electric power motors ever placed with any electric manufacturer has been placed with the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., by the Hurley Machine Company, Chicago and New York, manufacturers of the Thor electric home laundry machine. The Hurley Machine Company has decided to adopt the Westinghouse motor as its standard.

Upon the Thor home laundry machine is used a specially wound high-torque Westinghouse type DA motor, running at 1,700 revolutions per minute, sixty-cycles, 110 or 220 volts. Like most small motors it can be connected direct-

ly to a lamp socket. These motors are supplied with sliding bases and are mounted upon a small bracket, which is supported by a cross arm extending between two legs of the washer. The motor pulley is belted directly to the counter-shaft, which in turn is connected to the reversing mechanism that drives the washer, and also to the pulley operating the wringer. Mechanical clutches, which are operated by turning a small rod, throw into action the washer or the wringer, or both, according to the desires of the operator.

Store-Front Lighting in Belvidere.

The merchants on the main street of Belvidere, Ill., have combined to secure a display of store-front lighting which has transformed this street. The effects are shown in the accompanying illustration. The lamps consist of twelve-volt, ten-watt, Mazda units, which are fed through a transformer having a ratio of twenty to one from a 240-volt sign circuit which was already available. The wires are strung from a messenger wire which is supported by the telegraph posts with the ordinary catenary construction. A pair of No. 6 copper wires is used at a height of twelve feet above the curb and the lamps are placed four feet apart. The installation was designed by N. M. Argabrite, general manager of the Public Service Operating Company, and the construction was under his immediate direction. The lamps were supplied by the Buckeye Electric Company.

NIGHT VIEW OF MAIN STREET, BELVIDERE.

"Security" Electric Reading Lamp.

The electric portables in use in homes have usually been of the fancy-art-glass or heavy-colored-glass variety, and the matter of volume and quality of light has been almost wholly neglected.

To meet the demand for an electric reading lamp with an adjustable reflector shade, the Goshen Stamping and Brass Company, Goshen, Ind., has recently placed on the market a novel type of electric portable lamp.

"SECURITY" READING LAMP.

The ten-inch green plated dome shade is supported by a special jointed "Security" arm that centers the shade and lamp over stand, regardless of the angle of light, and when the shade is moved to the desired angle it remains where placed without the use of clamps, set screws or other troublesome devices.

In order to do away with some of the nickel-in-the-slot telephones, the Chicago Telephone Company announces that it is ready to install telephone meters in such cases as the customer desires it.

A New Starter for Induction Motors.

The Cutler-Hammer Manufacturing Company, in view of the increasing application of the induction motor, has recently placed on the market a starter for moderate sizes of polyphase slip-ring induction motors. This starter is the sliding contact type similar in appearance to the Cutler-Hammer squirrel-cage motor starter developed some time ago. It it convenient, compact, easily operated, and can be attached to the wall, or placed wherever may be most convenient. The resistance is mounted on the rear of the face and no extra wiring is needed as is the case where the resistance is mounted separately. The only wiring required is to connect the slip rings of the motor to the three terminals on the face plate. The resistance used is of the grid type on the large sizes and of the tube type on the smallest sizes of starters.

The contact segments are of hard-drawn copper and can be easily replaced or interchanged without interfering in any way with any interior connection.

The brushes consist of a pair of contacts at each end of the lever. The leading contact of each pair is made of carbon while the other is made of copper. This insures long wear, as the carbon takes the arc, while the copper, which has a low contact resistance, carries the current.

A latch is provided for holding the lever in the running position, but this can be replaced, if desired, by a no-voltage release. In case of the current failing the primary circuit is then automatically opened and the rotor resistance re-inserted. An overoad attachment can also be provided to open the primary circuit and cut in the resistance in the secondary when the motor is overloaded.

ALTERNATING-CURRENT MOTOR STARTER.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, NOVEMBER 12.—Speaking at the inaugural meeting of the Illuminating Engineering Society in London on Tuesday, S. E. Doane, of the American National Electric Light Association referred to the good work which is being done by the American Illuminating Engineering Society in the education of architects toward appreciating proper standards of illumination. He also drew attention to the special series of lectures which have been held at the Johns Hopkins University. Thanks mainly to its efforts, the International Congress of Hygiene at its convention in Brussel this year considered illumination, and although the Government delegates did not feel in the position to recommend immediate legislation, yet there was a very distinct feeling that illumination must eventually be taken in hand by Governments in relation to factories in the same way which ventilation and other matters are dealt with.

C. A. Gould, of the Gould Storage Battery Company, was in London this week giving evidence in the action regarding the contract he entered into in 1906 with a Dr. Lehwers to supply electric batteries for the London Electrobus Company. He is to be congratulated on having scored a success, for the jury, obviously dissatisfied with the case for the defence of Dr. Lehwers stopped it and forced the parties to come to terms.

A conference has been held between representatives of the Electrical Contractor's Association and the Municipal Electrical Association with regard to the proposed bill to confer electric wiring powers upon all municipalities. It does not seem that it should be difficult to arrive at some amicable arrangement between the two sides, especially as most municipal engineers do not desire actually to carry out wiring themselves but seem to wish for the powers, in order to liven up the contractors and make them more energetic. If any agreement can become to it will certainly save much money both of the taxpayers and the contractors.

The Postoffice this week opened its new electric power station which has been erected on the Thames near Blackfriars Bridge. The designs for this station were prepared several years ago before the long agitation as to power safety in London and the consequent large reductions in prices. Had this been foreseen, I have it on the authority of a Postoffice official that it is probable the power station would never have been built, as owing to the comparatively small size, the cost of generation will not establish a record. The full capacity of the station is 2,500 kilowatts, and there are three substations in the new buildings to be lighted on the other side of the river; where the 6,600-volts three-phase current is converted to direct current. The load to be supplied immediately includes lighting, charging of telephone batteries, and small motor work on the new General Post Office buildings, and also power for the pneumatic services, as the existing steam-driven air pumps are being replaced by electrically-driven pumps. G.

CANADA.

(Special Correspondence.)

OTTAWA, ONT., November 19.—The town of Mitchell, Ont., has carried a by-law by a large majority to take Niagara power from the Hydro-Electric Commission.

The Shawinigan Water & Power Company, of Shawinigan Falls, Que., contemplates an issue of $500,000 debentures for improvements and extensions.

The Sault St. Louis Light & Power Company, of Montreal, is applying to Dominion Parliament for an act extending the delay fixed for the completion of the Company's works, and for other amendments.

The Bell Telephone Company has applied to the town of Whitby, Ont., for a five years' exclusive franchise. The Markham & Pickering Independent Telephone Company is opposing the Bell Company's application and is willing to come into the town on a competitive franchise. The ratepayers will decide the question soon.

The City Council of Quebec city has decided to allow the Dorchester Electric Company to enter that city from the South Shore to carry on business there. Among the conditions imposed ,and accepted by the Company, is the construction of works in the city to cost $200,000; not to sell their powers to any other company without the consent of the City and payment of a penalty of $50,000; to place poles only in streets chosen by the city engineer; to charge ten cents per kilowatt hour; to pay $1,000 every time the Company infringes the conditions of the contract.

The application of the various telegraph companies doing business in Canada, for approval of their message forms, came recently before the Dominion Board of Railway Commissioners. During the discussion of the application, a question arose as to the liability of a telegraph company for a time table, in transmitting a message. Up to the present time, the telegraph companies have been liable for the cost only of an ordinary message, in the event of a mistake being made, and of fifty times the amount in the case of a repeated message. It was suggested by the board that a maximum penalty of $500 be fixed, but decision was reserved.

The Marconi Wireless Telegraph Company, during its application to the Board of Railway Commissioners for approval of its tariff of tolls between land stations down the St. Lawrence, raised the question of jurisdiction concerning rates on messages from ships at sea to land. The chief commissioner declared that a foreign or other ship, in Canadian waters, is as much under the jurisdiction of the board, as regards wireless rates, as a person on land is subject to the laws of the land. There has been a long fight over the alleged refusal of the Marconi Company to accept messages from ships equipped with another system of wireless. The United Wireless will, it is annouced, enter an application to the board to compel interchange of messages. The board reserved judgment on the question of tolls. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

POWER FROM THE SEVERN RIVER, ONT.—The hydroelectric power development at "Big Chute," in the Severn River, Ont., marks a new era for an important territory in the Georgian Bay district. The Severn River has a watershed area of about 2,250 square miles, including such important bodies of water as Lake Simcoe and Lake Couchiching, which insure an ample and steady flow of water. Nature has provided, at the Big Chute, one of the simplest and easiest power developments in Canada. It has made it possible to dam the river at a minimum of cost, and produce 4,000 horsepower of electrical energy. Construction has been carried on for about a year, with the result that the dam is complete, and the power house, transmission line and distributing stations are almost ready for operation. W.

MORE POWER FOR PORTLAND, ME.—So rapid has been the industrial growth of Portland that the power demands have exceeded the capacity of the two power stations of the Consolidated Electric Light Company at North Graham and West Buxton. The Consolidated Company is now to install a power plant on the Saco River at Bonny Eagle and construction has begun. This new power station is to be, eventually, the largest and most important electric power station in Maine. The first facilities which will be installed will develop 6,000 horsepower, which is nearly equal to the present amount developed by the two power stations at present in operation. Additional power will be transmitted to the city by three transmission lines working at 20,000 volts. This will be stepped down to 2,300 volts when it enters the city.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission gave a hearing recently upon the application of the receivers of the Hudson River Electric Company for approval of and permission to execute a contract for public lighting in the village of South Glens Falls and to operate under a franchise granted by that village.

Abraham J. Rose and George B. Curtiss appeared for the applicant company. Loyal L. Davis, village attorney, South Glens Falls, appeared in favor of the application before the Commission. Jenkins, Kellogg & Barker of Glens Falls appeared for the Glens Falls Gas & Electric Light Company and United Gas, Electric Light & Fuel Company, in opposition to the application.

The Commission pointed out to the applicants that it had been the policy of the Commission not to allow competing companies to enter into small communities where existing companies were giving adequate service at reasonable rates.

At Albany, on December 12, an adjourned hearing will be held on the petition, at which time the applicant company intends to offer evidence as to the inadequacy of the present service given by existing companies in South Glens Falls.

The Commission has granted the application of William Stock for permission to transfer to the Hannibal Electric Company, and the application of that company, Charles A. Cox and Ernest W. Rice, of Hannibal, N. Y., and the Oswego River Power Company to take over rights and franchises for the construction of an electric distributing plant to serve the village of Hannibal and the towns of Hannibal and Granby in Oswego County. No other corporation is at present serving these communities with electric lighting. T.

COMMISSION NEWS FROM MASSACHUSETTS.

(Special Correspondence.)

Pursuant to a resolution of the Massachusetts Legislature, the railroads terminating in Boston have made reports relative to the electrification of their terminals. The railroads are the Boston & Albany, the New York, New Haven & Hartford, and the Boston & Maine, and the reports are to be considered by the Railroad Commission, the Metropolitan Park Commission, the Boston Transit Commission, and the Harbor and Land Commission acting as a joint commission, which is to submit to the next Legislature a bill providing for the electrification of all railroads of standard gauge in the metropolitan district within a stated time. The zone in which electrification was considered reaches about fifteen miles from Boston, and on a few branches to twenty miles. The estimated cost on the Boston & Albany is $6,413,300; on the Boston & Maine, $18,889,192; on the New Haven, $13,862,750.

A joint report for the New York, New Haven & Hartford and the Boston & Maine Railroads was made by E. H. McHenry, of the former company. He favors an overhead system of supply at 11,000 volts alternating, twenty-five cycles. No substations would be required. The total equipment required would be equivalent to 461 miles of single track, and the items of expense are as follows:

Power plant	$ 6,000,000
Transmission lines and overhead contact system	3,850,240
Suburban terminal shops and inspection facilities	1,417,000
Heavy repair shops	400,000
Electric locomotives	6,725,000
Spare parts for electric locomotives	336,250
Multiple unit motor cars	6,960,000
Multiple unit trail cars	5,014,100
Spare parts for multiple unit cars	299,352
Signaling	1,750,000
	$32,751,942

This contemplates the use of sixty-four electric locomotives for the New Haven service and ninety-eight for the Boston & Maine. The equipment estimates attached to this report indicate that equipment must be provided for the operation of 14,630 daily train-miles, based upon the summer schedule of 1910. This is the theoretical or time-table mileage. The total actual mileage, including deadheading and helping, is 17,286 miles. These estimates are based upon a plan for electrification within the Metropolitan District of Boston in literal compliance with the request of the Legislature, which in no wise represents the scope and method of development which would naturally be favored by the railroad companies in interest. The proposed restriction of the operation to the Metropolitan District establishes limits which are purely artificial and arbitrary, having but little relation to the flow and volume of traffic, and makes necessary the establishment of costly intermediate terminals at some thirteen points on the district boundaries for accommodating both steam and electric motors. All trains passing through these transfer points will be subject to delays of three or four minutes in both directions, and, accordingly, the improved service within the Metropolitan zone will be gained only by sacrificing the commercial interests of many important secondary centers and outlying points, such as Marblehead, Salem, Lawrence, Lowell, South Framingham, Walpole, Brockton, Whitman and Greenbush, which communities will be less well served than at the present time. Similar conditions forced the extension of electric service on the New York division of the New Haven Company to Stamford, and on the New York Central lines to White Plains and Yonkers, although not required by the act of the Legislature, as such further extensions were necessary in order to avoid the cost and delays incident to engine transfers within suburban limits.

The problem in its general nature is altogether different from the conditions at New York, as in the latter case the entire traffic of the New York, New Haven & Hartford and New York Central Railroad Companies within the city limits is concentrated upon a single four-track route between the Grand Central Terminal and Woodlawn, while, on the contrary, at Boston the suburban business is diffused over a great area, requiring the equipment for electric operation of not less than twenty through routes and branches, with a corresponding effect upon first cost and operating charges. Notwithstanding the more favorable conditions at New York incident to the greater density of traffic and the simpler track system in the region served by the New Haven and New York Central Railroads, the records of the New Haven Company demonstrate that under present conditions the electric train service not only fails to earn any interest upon the very large amount of capital invested, but that it has also increased the cost of operation, and with the less favorable conditions in the vicinity of Boston it is impossible to escape the conclusion that the deficit in fixed charges and operating expenses will be still greater. In explanation of this disappointing result, it may be stated that the experience of the New Haven Company in operating a mixed steam and electric service has proven very unsatisfactory. The annoyances and losses due to smoke, cinders, steam and noise are at best only alleviated without being eliminated, while at the same time so large a proportion of the expenses of both methods of operation is retained as to prevent the realization of the fullest degree of economy of either system. This becomes more apparent when it is considered that the power stations, if provided for passenger requirements only, will have a large unused capacity between the hours of peak load, which otherwise could be utilized to very good advantage for the transportation of freight, and more particularly as the occupation of tracks by passenger trains during the hours of peak load acts automatically to limit the simultaneous operation of freight trains at such times. Thus little or no additional investment in power houses is required for freight operation, and similarly the overhead track equipment serves equally well for both passenger and freight traffic, which makes it practicable to extend electric operation to include all classes of service at the cost of only the additional engines and the equipment of yard trackage required for freight service. It therefore seems quite safe to conclude that no general substitution of electric for steam traction should be made unless the substitution is complete, including passenger and freight operation and ward-switching in addition, and also that in making such substitution the operation should be extended to include the full length of run or engine district, in order to avoid the uneconomical subdivision of the present train runs, together with the added expense and delays incident to intermediate engine transfer stations.

It would seem altogether more practicable to at first restrict the substitution of electricity for steam to a few of the more important routes, subsequently extending the system as rapidly as consistent with the financial conditions and the public needs.

The Boston & Albany report was prepared by A. H. Smith, the vice-president and general manager. It proposes electrification as far out as South Framingham, using the third-rail system with direct current at 1,200 volts. It would be necessary to equip 128 miles of single track and use sixteen electric locomotives and sixty-two motor cars.

The Newton Lower Falls branch of the Albany is already electrified, so the only sections of the road on which studies were required were the four-track main line from a junction with the South Station and the double-tracked Highland branch of the Newton circuit.

In his report Mr. Smith says that there has been embraced in the studies the electrification of some of the sidings and local freight stations on the main line, between Cottage Farms and Kneeland Street yards. It is assumed by the management that the purpose of these studies is to ascertain the difficulties which will be encountered in the elimination of the noise and smoke of steam locomotives from the densely populated area of Boston, and the purpose, therefore, would not be accomplished without considering the electrification of the freight engines employed in handling freight upon these particular sidings and yards.

It has been deemed wise to assume that certain changes would first be made in the main track and station arrangements. By continuing the four tracks from Trinity Place to connection with the South Station, where there are now three tracks, and arranging the four-track main line for right-hand operation, so that the two southerly tracks will both be operated east bound, and the two northerly tracks west bound. The adjacent tracks now operate in opposite directions, having been primarily so arranged for the Newton circuit. The above rearrangement will place all local trains upon the outside tracks and the high-speed trains on the inside tracks, and thus make it unnecessary for passengers to alight from trains upon tracks which are under operation, which might be quite undesirable for a material increase in traffic, as well as on account of the numerous electrical appliances which would be introduced in the track structure. This change in the method of operating the tracks will, of course, necessitate some changes in the station buildings, platforms, overhead bridges, subways, etc. These changes are so intimately associated with the studies that they cannot be ignored, and while they might ultimately be made desirable by a large increase in the operation under steam traffic, they would be immediately precipitated by the adoption of electricity, and it is necessary to consider at this time the cost of the work as a part of the general plan.

The effect of the proposed electrification upon the finances of road is treated at length. Mr. Smith says that the gross revenue derived by the Boston & Albany in the district under consideration for electrification, including return tickets, single-trip tickets, mileage proportion for traffic entering and leaving Boston for points west of South Framingham, is approximately $1,300,000. The visible operating expense of affording this service under steam operation at the present time, without any interest whatever upon the large investment for right-of-way, tracks and structures, is slightly in excess of the gross receipts. If to this present deficit there be added the additional annual expense as the result of electrification, $539,191, the net revenue above operating expenses which accrues to the Boston & Albany Railroad as a whole from the business handled in and out of the city of Boston between all points on the road will be practically absorbed, thus leaving no net revenue from such service to meet existing obligations or those which would be created by this new investment. The solvency of a transportation company is of paramount importance to the public as well as to the railroad. Insolvency necessarily means inefficient service, and inefficient service means incon-

venience and commercial and industrial calamity to the public. It would therefore seem imperative that any act providing for the electrification of steam railroads under such circumstances, empowering the proper Board or Boards to determine the manner in which such work should be prosecuted, should also empower the Board or other properly constituted authorities to permit the railroad companies to assess all passengers and traffic using the facilities with a terminal charge sufficient to bear the financial burdens imposed, with some additional profit to the operating company for performing the service and assuming the additional responsibilities and liabilities necessarily introduced. This would seem more consistent and equitable than to impose it upon other cities, villages or rural communities in local fares or other forms of transportation which receive no benefits from the new form of transportation employed. The Boston & Albany Railroad has no material sources of income except the receipts from transportation afforded the public. If the public elects through legislative mandate to have that service provided through the use of more costly appliances and methods than formerly, the conclusion is inevitable that the public must ultimately pay the cost.

COMMISSION NEWS FROM GEORGIA.

(Special Correspondence.)

The Railroad Commission has duly approved a $20,000,000 stock and bond issue of the Georgia Power Company. It is said that by this the Westinghouse Electric Company gains control of over 100,000 horsepower of available water power. The new company, with the Smith interests, representing the S. Morgan Smith Manufacturing Company, will absorb the North Georgia Electric Company, the Etowah Power Company, and other plants located at Dunlap, Tallulah, Buford and Newman. These plants include practically all of the electric power plants on the Chattahoochee, Tallulah and Etowah rivers, it is declared. According to the terms of a contract as reported made, the Georgia Power Company will turn over to the Northern Construction Company, of Michigan, $10,000,000 in five-per-cent bonds, the bonds to be held by the Knickerbocker Trust Company, as trustee. The Northern Construction Company will also get, it is stated sixty per cent of the stock. The estimated cost of developments to be worked out by the Northern Construction Company is $11,000,000, the Knickerbocker Trust Co. to pay to the construction company, on the certificate of the engineer of the Georgia Power Company, money as it is derived from the sale of bonds as the development work progresses. L.

COMMISSION NEWS FROM NEW JERSEY.

(Special Correspondence.)

The Board of Public Utility Commissioners for the State of New Jersey has approved ordinances of the Townships of Glassboro, Wollwich and Washington, Gloucester County, granting franchises to the Gloucester County Electric Company.

The Board has also approved the ordinance of the Town of Morristown granting a franchise to the Morris County Traction Company.

The Board has also approved the ordinance of the City of Burlington granting a franchise to the Burlington Electric Light and Power Company. This franchise is for a period of fifty years and as originally passed by the City Council of Burlington was vetoed by the Mayor and passed over his veto. At the hearing upon the question of the approval of the ordinance by the Board of Public Utility Commissioners several amendments to the ordinance were suggested by the Board. These were agreed upon by representatives of the Company and City and were incorporated in a new ordinance which passed the City Council and was approved by the Mayor.

LIGHTING AND POWER.

(Special Correspondence.)

EUREKA, S. D.—The installation of an electric light system is projected. C.

SEYMOUR, IOWA.—The light plant, which was destroyed by fire, will be rebuilt. C.

CAIRO, GA.—It is reported that this city may enlarge the municipal electric lighting plant. The mayor should be addressed.

EAST ST. LOUIS, ILL.—Plans for the new St. Mary's Hospital, of which Dr. H. J. deHaan is in charge, include an electric lighting plant. Z.

BURLINGTON, N. J.—The City Council has granted a fifty-year lighting franchise to the Burlington Electric Light & Power Company.

NEWTON, ILL.—The City Council has placed orders for Westinghouse series tungsten lights for the streets, to replace the arc light system. Z.

HERMISTON, ORE.—B. A. and G. A. Chisholm have been granted a franchise to install an electric lighting plant here within the next six months. A.

PALACIOS, TEX.—C. D. Deal, of Colorado Springs, Colo., has purchased the electric light plant here from Clyde Randolph. He will make improvements to the property. D.

HIGHMORE, S. D.—T. J. Wixson and associates of Stella, Neb., will install an electric light system here. A franchise has ben submited to the council for early action.

CASSELTON, N. D.—The plant of the Casselton Electric Light Company has been purchased by Lloyd Lynch and Chester Hallet, who will put it in repair and re-open it. C.

FREMONT, NEB.—The Fremont Gas & Electric Light Company let the contract to Richards, Keene & Company for the erection of a one-story cement-block building, 30 by 80. C.

CENTRALIA, WASH.—The Council has adopted the plans of City Electrician Harmony for the installation of a complete lighting plant, the estimated cost of which is between $40,000 and $45,000.

INDIANAPOLIS, IND.—The Board of Public Works has ordered the public service companies that sell electricity to file rules and regulations and schedules of classified rates charged consumers. S.

CLARKSTON, WASH.—The Lewiston-Clarkston Improvement Company has completed plans for the improvement of its lighting system here. The money expended will be approximately $100,000. A.

COAL CITY, ILL.—The factory of the McComber & Whyte Wire Rope Company will use electricity to operate its machinery. The power will be supplied by the Illinois Valley Light and Power Company. Z.

ROCHESTER, N. Y.—The Rochester Railway & Light Company contemplates the installation of 200 more illuminated fire-alarm boxes by next spring. There are about a hundred of these in the city.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company, of which E. H. Libby is president, has commenced work on enlarging the steam auxiliary power plant of the Company at Snake River. A.

GALESBURG, ILL.—Two new vertical boilers with a capacity of 1,200 horsepower have been ordered by the City Council for installation at the municipal lighting and waterworks plant. This will double the capacity. Z.

BLUE HILL, NEB.—The Village Board recently let the contract for the construction of an electric light plant to the Alamo Engine & Supply Company of Omaha. A seventy-five-horsepower engine is to be installed.

INDIANAPOLIS, IND.—The Royse Electric Company of this city has changed hands and will be controlled and operated by a new company headed by Robert P. Olbinger. The chief office will be at 124 South Meridian Street. S.

CHIHUAHUA, MEX.—The Sierra Mining Company will install a hydroelectric plant at its mines in this state. Under the terms of the concession granted the Company by the state government it must complete the plant within eighteen months. D.

MOLINE, ILL.—Merchants between Fourth and Fifth Streets on Fifteenth Avenue have formed the "400" Club for the purpose of promoting that section of the city and to install a system of ornamental lights. M. R. Carlson is president and Fred Berglund secretary and treasurer. Z.

KEEWATIN, MINN.—The contract for the erection of a brick power house, 50 by 72, at the new power plant, has been let to C. A. Kilander, of Hibbing, Minn., for $4,650, and for the electrical equipment to the Enterprise Manufacturing Company, of Minneapolis, Minn., for $4,264. C.

ASHEVILLE, N. C.—The Asheville Electric Company has let the contract to B. J. Luther and Company, of Baltimore, for the construction of certain extensions to the electric lines in Asheville. Other contracts will be let later, making several miles of lines in West Asheville. L.

VANDALIA, ILL.—Contracts have been let by the city for the purchase of a new 250-horsepower engine, 150-kilowatt dynamo, new switchboard and other machinery for the municipal electric lighting plant. Later the pump at the waterworks station will be operated by electricity. Z.

WAUSAU, WIS.—The Mosinee Electric Company, which was recently incorporated, will generate and distribute electric power for lighting and will deal in electrical appliances and machinery. The incorporators are Neal Brown, C. S. Gilbert and M. C. Ewing. The capital stock is $15,000.

MARION, ALA.—The Marion Electric Company has been incoroporated by R. Kent Coe, Hugh Mallory and R. L. Ellis, of Selma, Dr. T. J. Krause, Lamison, Ala, and Paul Lovelace, Marion. This new company will take over the plant of the recently purchased Marion Light & Power Company. B.

FORT LUPTON, COLO.—After repeated refusal this place has at last consented to grant to the Northern Power Company, a franchise to operate within the town limits. The Company will supply the municipality with light and power, and many ranchers along its lines will take advantage of its power.

ALAMOGORDO, N. M.—The Alamogordo Improvement Company, which is installing a hydroelectric plant in Box Canyon near here, at a cost of $60,000, contemplates the construction of a

series of these plants in that region for the purpose of providing power for the towns and industries of this section. D.

IPAVA, ILL.—F. R. Dennis of Peoria has submitted to the Village Board an offer to sell to the muncipality the electric lighting plant which he owns here. Installation of an entire new plant by the village also is advocated. Z.

DANTE, VA.—Contracts have been awarded by the Clinchfield Coal Company of this place for two 1,500-horsepower turbines and ten 500-horsepower motor-generator sets, with switchboard and necessary accessories. The machinery will be furnished by the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa.

PINE RIVER, MINN.—The power dam which is being built by Webber & Hill across the river is rapidly nearing completion. The cement work is practically all done except a few finishing touches and the machinery is being placed. It is expected that power will be furnished by December 1, at the latest.

CAMPBELLSPORT, WIS.—Campbellsport is to have a complete, modern electric light plant. A deal was recently closed whereby Richard Thomas of Milwaukee disposed of his entire interest in the present plant to several Milwaukee capitalists, who have already begun preparations to erect a new plant near the site of the old one.

FRESNO, CAL.—General Manager A. G. Wishon announces that the San Joaquin Light & Power Company will extend its power line to the King's River Rock Crushing Plant, where the Sharp Fellows Company is constructing one of the largest crushing plants in the state at the end of the Santa Fe extension line now under way.

MASON CITY, IOWA.—A consolidation of the ownership of the Forest City and Garner electric plants has been effected by Frank and H. F. Kellogg, of Seymour. Frank Kellogg has purchased the stock of the Forest City plant from M. E. Barton, former owner, and will take complete charge. The Seymour plant is also owned by the Kelloggs.

AUGUSTA, GA.—The City Council has appointed a committee to investigate the subject of better street lighting and the establishment of a Great White Way. The construction and operation of a municipal lighting plant has been suggested and discussed but no definite movement in that direction has been taken. At present the Augusta Railway & Electric Company lights the streets of the city under a contract. B.

PACHUCA, MEX.—The stockholders of the Compania Irrigadora de Luz y Fuerza del Estado, S. A., decided at a recent meeting to change the name of the Company to the Compania de Luz y Fuerza de Pachuca, S. A. The following officers were elected: President, R. C. Brown; vice-presidents, Emilio Pardo and Louis Riba y Cervantes; E. D. Trowbridge, director general, and Antonio Pacheco, general manager and secretary. D.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company has completed its powerhouse at St. Croix Falls, Wis. Improvements there are to include the installation of two units consisting of a water wheel and a 2,500-kilowatt generator each, and two more are possible, which would make eight 2,500-kilowatt units. Transmission capacity to substation A at the Minneapolis city limits has been doubled by the erection of a steel tower line. Three transformers have been added at the substation to handle the increased load.

SILVER CITY, N. M.—Boulware & Johnson, of Silver City, will install a hydroelectric plant of 4,000-horsepower on the upper Gila River. The firm's application for the use of 100 second feet of flow of the water of the river to develop the electrical energy has been approved by the territorial engineer, Vernon L. Sullivan. It is stated that the installation of this plant involves the construction of a dam across the river and the laying of a pipe line about twelve miles long. The project will cost about $1,200,000, it is stated, and has been financed in Philadelphia. D.

VINCENNES, IND.—Suit has been filed against the Vincennes Light and Power Company by the Blackhawk Light, Heat and Power Company, asking for a receiver of the defendant company. The complaint, which is filed in the Federal court, alleges that the Vincennes Company has failed to comply with the profit sharing agreement between the two companies and that no effort has been made to extend the plant or keep the property in repair. The petition asks that the property be restored to plaintiff in order to permit repairs, extensions, and the installation of modern equipment. S.

PORTLAND, ORE.—The Independent Electric Company, recently incorporated at this place with a capital stock of $100,000 by H. G. Fleischauer, F. W. Hall and Ernest Hardy, has completed negotiations for the purchase of the Hillsboro Water, Light & Power Company and the Haines Light & Power Company. The latter company controls a hyroelectric power plant sixteen miles from Forest Grove, Ore. The new company announces plans for extensions from the Haines plant to the towns of Beaverton, Orenco, Cornelius, Diley, Gaston and other points along the Oregon Electric Railway between Beaverton and Forest Grove.

SAN FRANCISCO, CAL.—Since the sale of the entire output of electric power of the Great Western Power Company to the Pacific Gas & Electric Company, there has been renewed activity at and near the former company's plant at Big Bend on the Feather River. A corps of surveyors in charge of L. P. Cornell is at work, and various reports of contemplated power plants have been in circulation. It is understood that the company is figuring on the advisability of boring a tunnel four miles long from Bartel's Bar to Big Bar on the Feather River, thus securing a volume of water and a fall sufficient to double the capacity of the plant. A.

WATERLOO, IOWA.—The City Council is considering an ordinance to fix the standard for street lighting posts in Waterloo, the measure having passed first reading. Poles shall be thirteen feet six inches high with a top globe sixteen inches in diameter and four side lamps with globes roughed inside. All are to be equipped with 100-watt tungsten lights. Poles are to be placed ninety feet apart, or four to a block, with corner poles fifteen feet from street intersections. The cost of installation, $55 per pole, will be borne by the property-owners and after the regulation number of eight to a block is in place cost of maintenance will be borne by the city. Z.

ISHPEMING, MICH.—The Au Train River is the latest upper Michigan stream to be harnessed and its power is about to be put to industrial use. A hydroelectric plant has been erected at the Twin Falls near Dixon, Alger County, by the Cleveland Cliffs Iron Company interests, and as soon as the transformers are installed the machinery will be put into operation. The current generated will be transmitted to Munising, thirteen miles distant. The power will be used at the Munising paper mill. It is estimated that the Twin Falls plant will be capable of furnishing from 250 to 800 horsepower.

NEWCASTLE, IND.—A movement has been started by cities owning and operating municipal light and water plants to secure a law by the incoming legislature which will allow such cities to issue bonds to make improvements and extensions to their municipal plants. It is admitted that the municipal plants are deteriorating and that many cities are unable to make needed improvements from the profits of the plants. Indiana cities can only issue bonds to the extent of two per cent on the taxable valuation and all of the cities owning plants have, it is said, already reached their limitation allowed by statute. If the proposed law is secured there will be a great era of improvement in municipal plants during the next two years. S.

MEXICO CITY, MEX.—The Compania Irrigadora de Santa Maria, which was recently organized here, will install a large hydroelectric plant in the Jojutla district, State of Morelos. A waterfall on the Apatlaco River will serve to generate the electrical energy. Power transmission lines will be constructed to industrial centers and plantations of that region. The Company will also construct an extensive system upon its own lands, using electric power to operate the pumps. Emilio Pardo, former minister from Mexico to Belgium, is president of the Company; Lieutenant-Colonel Armando I. Santacruz, a member of the military staff of President Diaz, is vice-president and treasurer, and Indalecio Sanchez Gavito, Jr., is secretary. D.

MARBLE FALLS, TEX.—E. C. Alexander and associates who are erecting a great reinforced concrete dam across the Colorado River here for the purpose of affording a water supply for generating electricity at their 30,000-horsepower hydroelectric plant that is also being installed have taken preliminary steps toward constructing a power transmission line that will run from here to Temple, serving en route the towns of Taylor, Georgetown, Granger, Bartlett and Holland. It is planned to also construct lines to Austin, San Antonio, Llano and a number of other towns. W. H. Zimmerman, president of the Zimmerman Construction and Engineering Company of Chicago has been making a reconnaissance of the route of the proposed Temple line. D.

ROCK HILL, S. C.—The report of T. E. Cothran, electrical engineer, to the town council of Rock Hill, on the feasibility of purchasing the plant of the Rock Hill Water and Electric Company, has been received, and the engineer has indicated that the value of the plant is in the neighborhood of $92,000, including $22,000 recently invested in improvements. It is said that the Board of Public Works has recommended to the Council that authority be granted them to make an offer to the owner, Martin Maloney, of Philadelphia, for the purchase of the plant, at a figure approximating $100,000, and that if the said offer be not accepted without delay, the Council instruct the board of public works to proceed with the task of installing a lighting plant and a water plant for municipal purposes. L.

MARSEILLES, ILL.—Work has begun on the construction of the $300,000 hydroelectric station of the Northern Illinois Light and Traction Company, a subsidiary of the Western Railway and Light Company or the McKinley lines. The power house will be located on what is known as the old pulp mill site. The building will be on concrete foundations resting on a bed of shale. The superstructure will be of steel and brick with tile roof and is to be completed within a year. A concrete bridge will be erected to the north of the power house and in addition to serving for railway purposes will be used to further a flume scheme. Twelve vertical turbine water wheels will be installed in individual flumes. Work will be supervised by F. R. Winders, representing C. W. Humphrey, of Chicago, consulting and designing engineer. Z.

ELECTRIC RAILWAYS.

(Special Correspondence.)

DEFIANCE, O.—The Defiance Interurban Railway Company has been incorporated by K. V. Haymaker, C. E. Bennett, T. C. Jacks, R. H. Holgate, and Robert Newbegin. The capital stock is $50,000.

PORTLAND, ORE.—President Josselyn, of the Portland Railway, Light & Power Company, announces that he will extend the Cazadero line three and one-half miles as quickly as the work can be done.

SAN DIEGO, CAL.—A petition, signed by 1,600 people has been submitted to the City Council asking that all future franchises of the San Diego Electric Railway Company be allowed to run for fifty years. A.

SEATTLE, WASH.—J. Frederick Thorne, representing local capitalists, has presented to the Council a plan for an interuban electric railroad. The road is proposed to run from Kirkland to Tolt, near the county boundary and will be forty miles long. A.

SPENCER, N. C.—The first motor car electrically propelled, to run over the lines of the Southern Railway through this point, passed Spencer on November 9 en route to Washington on the main line of the railroad, the car being in charge of A. Hesselton, demonstrator. L.

OAKLAND, CAL.—The Southern Pacific Railroad Company has petitioned for a renewal of its Seventh Street franchise which expired on Nov. 11. The franchise is asked for fifty years and the matter will come up for hearing on December 5. The line will be made a part of the Company's suburban electric system. A.

COLLINSVILLE, ILL.—The City Council has granted a franchise to the St. Louis & Eastern Traction Company for the operation of its lines on Clay Street of that city. Rights on Morrison Avenue were refused because of difficulties over the question of paving. Right-of-way has ben secured between Collinsville and Highland. Z.

BELLEVILLE, ILL.—Articles of incorporation have been filed by the Denverside Connecting Railway Company which will build an electric railway from the southeastern city limits of East St. Louis to the Mississippi River. The incorporators are Harry S. Kramer, Robert P. Munger, A. W. Baltz, Robert Gillespie and George G. Heller. The capital stock is $100,000. Z.

ROCHESTER, N. Y.—Following much negotiating by the Rochester, Syracuse & Eastern Railroad, backed by the powerful Beebe interests, to secure control of the Buffalo, Lockport & Rochester interurban line, it is stated on reliable authority that the deal is practically completed. It is understood that in all probability the Rochester Southern and Eastern Company will take possession of the Buffalo, Lockport and Rochester road any time during the next few weeks.

GREENVILLE, S. C.—The Greenville Traction Company, which is making some important changes in the local system, has decided upon the use of wooden poles to support the wires that will carry the current by which the lines will be operated. Four poles are to be used to the block on each side of the street where this system is to be installed. All other poles of the Traction Company will be removed on those streets where the four pole arrangement is carried out. L.

INDIANAPOLIS, IND.—The property and holdings, including franchises, etc., of the Indianapolis & Cincinnati Traction Company, was sold by master commissioner H. C. Allen, November 9, to John J. Appel, representing the bondholders and creditors, for $1,045,000. A new company is being organized to take over the property and operate the road. The bondholders of the Company will become stockholders in the new company. The road will be extended from Greensburg to Cincinnati next year. S.

GREENVILLE, S. C.—Vice-president and General Manager Clark, of the Greenville, Spartanburg and Anderson Interurban Electric Railway states that the contracts for the building of the road from Greenville to Belton, S. C., will be let simultaneously with the letting of the contracts for the building of the line northward to Mt. Holly, N. C., a distance in the latter case of 110 miles. The surveying corps has been ordered from the Greenville-Belton division to Mt. Holly, to take up the work at that end, surveying back to Greenville The route from Greenville to Belton is now ready for the beginning of grading and the building of the electric lines. L.

WEBSTER CITY, IOWA.—The Crooked Creek Railroad has been sold to the Fort Dodge, Des Moines & Southern Interurban Company which will electrify it and connect it with the main line by the construction of a spur either from Brushy to Gypsum City or from Lehigh to Lundgren, according to George Burnham of Milwaukee, president of the Crooked Creek line. Possession will be given January 1. The line is seventeen miles long running from Webster City to Lehigh and has an authorized capital of $500,000, of which $225,000 has been issued. The sale was made for $112,500. A street franchise will be sought in Webster City. Lands and coal mines owned by the Crooked Creek Company will be operated by a corporation which is to be known as the Lehigh Land & Coal Company. Z.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

KILBOURNE, O.—The Kilbourne Mutual Telephone Company has been incorporated by Charles F. Rodenfell and others.

CUERO, TEX.—A fire-alarm system is to be installed here as soon as necessary arrangements have been made with the telephone company.

OCONTO FALLS, WIS.—The Morgan Telephone Company has been incorporated with a capital of $1,200 by C. F. Mayer, M. Marcomiller, Adolph Peterson and R. H. Sharp.

CALUMET, OKLA.—The South Calumet Telephone Company has been incorporated with a capital of $5,300. The incorporators are Frank Hornberger, W. F. Reidener and H. O. McGowan.

VICTORIA, B. C.—Manager George H. Halse of the British Columbia Telephone Company states that the Company will next spring lay a new submarine cable to connect this city with Vancouver.

MT. STERLING, ILL.—Negotiations for the sale of the entire capital stock of the Mt. Sterling Telephone Company to the newly organized People's Electric Light and Telephone Company have been completed, and the transfer will probably be made not later than January 1. Z.

WAYCROSS, GA.—It is stated that the Southern Bell Telephone & Telegraph Company will improve its Waycross exchange. That a new building may be erected and that it is proposed to install a new switchboard system. The cost of the proposed improvements are said to be $50,000. B.

NEW CASTLE, IND.—The controlling interest in the Newcastle Telephone Company has been acquired by the Eastern Indiana Telephone Company of Winchester. The new owners announce that extensive improvements will be made and many toll lines be built to improve the local service. S.

MUNCIE, IND.—It has been announced that $25,000 will be expended by the Delaware and Madison Counties Telephone Company in improving and extending its system in the two counties. The principal work will be done at Gaston, Alexandria and Elwood. This work will be begun as soon as the material for the line can be bought. S.

EVELETH, MINN.—Work on the Mesaba Telephone Company's new toll line from Eveleth to Ely has reached Allen Junction, and will soon be completed. A new circuit is being installed from Gilbert to Biwabik, while better connections are being made between McKinley and Biwabik. The conections with Winipeg will soon be completed.

WAYCROSS, GA.—The local telephone situation has had added interest injected by the offer of T. H. Calhoun, of Ware County, to lease the Waycoss Bell Telephone system for one year and guarantee ten-per-cent dividends on the stated investment of $42,000. The Company claimed that it was making far less than this sum, and Mr. Calhoun then came forward with the offer mentioned. L.

ABERDEEN, WASH.—Negotiations are about completed for the construction of a telephone line to connect this city with Westport. The enterprise is backed by local shipping people and if consummated will enable them to have direct communication with the United States life-saving station at the entrance of the harbor, and by this means keep in touch with the arrivals and departures.

WABASH, IND.—The Citizens Telephone Company recently organized by the farmers and capitalized at $25,000 has decided to build a new telephone system at once. The exchange will be in Wabash and the lines reach out to and connect the numerous rural lines now separating in the county. An increase in rates by the old company prompted the farmers to build a new system. The material will be bought in a short time. S.

ASHEBORO, N. C.—Citizens having petitioned that arrangement be made for connecting the local Asheboro Telephone Company lines, independent, with the long distance service of the Bell Telephone Company, running into the town, a meeting between the Bell representatives and the State Corporation Commission was held recently to investigate the issue. The chief difficulty is in agreeing upon details and so forth, as to connections, there being a number of independent lines running out of the town, whereas the Bell Company is said to have generally stood for an exclusive use of its lines in long distance service. L.

DALLAS, TEX.—The Automatic Telephone Company which has just been organized here with a capital stock of $500,000 has taken the necessary preliminary steps to increase the capital to $1,500,000. The Company is just completing a 50,000-line exchange in this city at a cost of more than $200,000. It is stated that the additional capital will be used to establish exchanges in other cities and towns of the state and to connect them with long distance lines. Its plans contemplate co-operating with the several hundred independent telephone exchanges and systems in Texas. At a recent meeting of the stockholders of the Company the following directors were elected: J. C. Casler, Clarence Linz, Henry D. Lindsley, J. S. Kendall, J. F. Schoelikopf, H. D. Eberle, Frank Austin, F. X. Eberle, Rhodes S. Baker and C. F. Freeman. D.

ELECTRICAL SECURITIES.

Trading during the week was lighter and the market was firm at closing. The business was only about four-fifths of that of the preceding week and was nearly all of a professional nature. One third of the trading was in steel, and another third in Union Pacific and Reading. Money was easier during the week, call funds loaning down to two per cent. Time money is easy and not in very great demand. Sterling exchange was irregular, closing firm and but little changed from the previous week. Saturday's bank statement showed an increase of over $7,000,000 in surplus reserves.

Perry, Coffin & Burr are offering $500,000 United Electric Securities Company collateral trust five per cent bonds, maturing February 1, 1940, at 101½ and interest, yielding 4.90 per cent.

Henry L. Doherty & Company announce that subscriptions to Cities Service Company of $2,000 and under shall be allotted in full, and subscriptions for more than $2,000 shall be allotted plus twenty per cent.

The plant of organization of the Washington, Baltimore & Annapolis Electric Railway provides for $7,500,000 of first mortgage bonds, $2,500,000 to be held in the treasury; $2,500,000 preferred stock, of which $1,040,000 is to be reserved; common stock, $3,000,000. These are to take the place of existing obligations.

Application has been made to the Maryland Public Service Commission by the Consolidated Gas, Electric Light and Power Company, of Baltimore, for permission to issue $224,000 additional four and one-half per cent bonds of the authorized issue of $15,000,000 first mortgage four and one-half per cent bonds of that company, of which there are now outstanding $11,564,000.

DIVIDENDS.

American Railways Company; regular quarterly dividend of one and one-half per cent, payable December 15, as registered November 30.

Brooklyn Rapid Transit; regular quarterly one and one-quarter per cent, payable January 3 to holders of record December 10.

Detroit Edison Company; quarterly dividend of one and three-quarters per cent, an increase of one-quarter per cent over the previous disbursement.

Kings County Electric Light and Power Company; regular quarterly dividend of two per cent, payable December 1 to stock of record November 18.

New England Telegraph and Telephone Company; a dividend of $1.50 a share, payable December 31 to stockholders of record December 15.

New York and Queens Electric Light and Power Company; regular quarterly dividend of one and one-quarter per cent, payable December 1 to stock of record November 25.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Nov. 21.	Nov. 14.
Allis-Chalmers common	8	8½
Allis-Chalmers preferred	32¼	31
Amalgamated Copper	70⅝	68
American Tel. & Cable	*84	*84
American Tel. & Tel.	143	141¼
Brooklyn Rapid Transit	78⅛	76¼
General Electric	154⅛	152½
Interborough-Metropolitan common	21	20½
Interborough-Metropolitan preferred	56½	55⅛
Kings County Electric	123	123
Mackay Companies (Postal Telegraph and Cables) common	90	94¾
Mackay Companies (Postal Telegraph and Cables) preferred	73⅞	73½
Manhattan Elevated	140½	140
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	45	42½
U. S. Steel common	81½	77⅝
U. S. Steel preferred	117¾	117
Western Union	71	70½
Westinghouse common	71	69⅞
Westinghouse preferred	120	120

*Last price quoted.

BOSTON.

	Nov. 21.	Nov. 14.
American Tel. & Tel.	142⅛	141¼
Edison Elec. Illuminating	288	279
General Electric	154	152¼
Massachusetts Electric common	20⅝	20¼
Masachusetts Electric preferred	88¼	86½
New England Telephone	136	136
Western Tel. & Tel. common	17	17
Western Tel. & Tel. preferred	90	90

PHILADELPHIA.

	Nov. 21.	Nov. 14.
American Railways	43	42¾
Electric Company of America	11¾	11¾
Electric Storage Battery common	11¾	47
Electric Storage Battery preferred	47½	47
Philadelphia Electric	15⅝	15⅜
Philadelphia Rapid Transit	17⅝	16⅛
Philadelphia Traction	82½	81
Union Traction	39	39

CHICAGO.

	Nov. 21.	Nov. 14.
Chicago Railways, Series 1	78½	75
Chicago Railways, Series 2	22½	20
Chicago Subway	43¼	4½
Chicago Telephone	123	120
Commonwealth Edison	115	115
Metropolitan Elevated common	19	20
Metropolitan Elevated preferred	61	65
National Carbon common	120	135
National Carbon preferred	118¾	118

PERSONAL MENTION.

J. E. NOEGGERATH has opened an office, at No. 46 Wall Street, as consulting engineer. Mr. Noeggerath was formerly with the General Electric Company.

JOHN A. DENT, recently with the oil-pipe-line service of the New York Transit Company, has been appointed instructor in mechanical engineering at the University of Illinois.

JOHN S. CONWAY, of the United States Reclamation Service, has been appointed chief constructing engineer of the United States Light-house Service. The position was recently created by an act of Congress.

PROF. C. T. KNIPP, of the physics department of the University of Illinois, is in Europe on a year's leave of absence. He will spend the greater part of the year in Cambridge, where he will study under Prof. J. J. Thomson.

PROF. KAMMERLING ONES, of the University of Leyden, has put his eryogenic laboratory at the disposal of Mme. Curie. She will use the laboratory in carrying out her researches on radio-activity at low temperatures.

GUY E. PAYNE, of Chicago, has been appointed general superintendent of the Western division of the Postal Telegraph Company, succeeding T. W. Carroll, who goes to New York as assistant to General Manager Brooks of the Western Union.

DR. L. A. BAUER gave an illustrated address on November 10 at Colgate University. The talk, which was on "The Magnetic Survey of the Globe, and the Work of the Yacht *Carnegie*," was given under the auspices of the department of geology and biology.

WILLIAM GECKLER, of Rochester, N. Y., has assumed the position as manager of the properties of the Inter-State Telephone Company at Springfield, Ill., succeeding Charles R. Peel, who has been made general manager for the same company, with headquarters at Aurora, Ill.

SIR WILLIAM RAMSAY, on the occasion of the visit of a number of gentlemen to the British Radium Factory, Limehouse, made the statement that radium has for the first time been produced in Great Britain from British ore. The process of purification has been carried out since June at Limehouse.

F. G. BOLLES, commercial engineer of the Allis-Chalmers Company, has resigned in order to devote his entire attention to the Reliance Engineering & Equipment Company, 1417-19 Majestic Building, Milwaukee, in which he has an equal interest with C. A. Tupper and others. The company will remove, on December 1, to offices in the Engineering Building.

WALTER BRINTON, superintendent of the Manganese Steel Department of the Taylor Iron & Steel Company's plant at High Bridge, N. J., since 1895, has resigned, and has accepted a position as consulting engineer for the Edgar Allen American Manganese Steel Company of Chicago Heights, Ill., and New Castle, Del. Mr. Brinton's headquarters will be at the New Castle plant.

PROPOSALS.

MACHINERY FOR COAL DEPOT.—Bids are asked until December 3 by the Bureau of Yards and Docks, Washington, D. C., for installing in the naval coal depot at Tiburon, Cal., two boilers, one boiler-feed pump, one steel stack, one motor-generator set, one transformer, one switchboard, wiring, piping, etc., and installing a generating set to be furnished by the government.

POST OFFICE, MONTGOMERY, ALA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until December 15 for the miscellaneous changes at the extension to the United States court house and post office, Montgomery, Ala., in accordance with the specification and drawing, copies of which may be had of the custodian at Montgomery, Ala., or at the Supervising Architect's office.

INDUSTRIAL ITEMS.

THE THOMAS WRIGLEY COMPANY, Chicago, Ill., is sending out folders on the Wrigley emery-wheel dresser and other Wrigley specialties.

HENRY H. HUMPHREY, St. Louis, Mo., recently announced a change in offices from Suite 1505 Chemical Building to Suite 1312 in the same building.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., mentions in the November number of *The Electrical Trade*, the products of the Electrical Alloy Company, of Morristown, N. J.

THE TUNGSTOLIER COMPANY, Cleveland, O., which has purchased the Conneaut Company, of Conneaut, O., will shortly remove its office and factory to Conneaut where headquarters of the company will be established. In addition to the Conneaut Company the Tungstolier Company has purchased and now operates the Cleveland Gas & Electric Fixture Company, and the Pennsylvania Gas & Electric Fixture Company. The company also owns and operates the Tungstolier Company of Canada, Limited.

F. N. MANROSS, Forestville, Conn., manufacturer of hair springs, has recently purchased the business of the Stephenson Hair Spring Company of Forestville, Conn. The purchase includes all the stock, machinery, good-will, etc., of the Company.

THE COOPER HEWITT ELECTRIC COMPANY, Hoboken, N. J., announces that the equipment of its new works is complete, and also that its general offices have been moved from 220 West Twenty-ninth Street, New York, to Eighth and Grand Streets, Hoboken.

THE SANITARY PUMP COMPANY, Dayton, O., describes in Bulletin No. 12 the Sanitary duplex double-acting power pump and pneumatic water system. In addition to a number of illustrations of gas and motor-driven duplex pumps with tanks, a complete price list with dimensions, weights, etc., is given.

THE SHELTON ELECTRIC COMPANY, New York, N. Y., announces that it has moved its offices to No. 13 West Forty-second Street. From this office the Company will continue to sell its line of electric and storage battery vibrators, massage machines, electrical hair dryers and therapeutic appliances.

THE DEARBORN DRUG & CHEMICAL WORKS describes in a recent booklet its method of treatment of boiler feed waters. The Company's preparations convert crystalized scale formations having an affinity for hot metal into tannates, gallotannates and other compounds which do not crystallize and are easilly removed.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY, Meriden, Conn., states that the Vanderbilt Cup of 1909 and 1910 was won in an Alco by Grant, who used a Connecticut steering-wheel switch. This little switch on the steering wheel put the absolute control of his car under his thumb without removing his hand from the steering wheel.

THE L. E. KNOTT APPARATUS COMPANY, Boston, Mass., has issued in pamphlet from, a short treatise on wireless telegraphy. The pamphlet, which was prepared by E. B. Moore, deals with the methods and operation of modern wave-telegraphic apparatus. A number of drawings and wiring diagrams aid the reader in obtaining a clear idea of the subject.

THE STEEL CITY ELECTRIC COMPANY, Pittsburg, Pa., describes in a recent bulletin the Fullman adjustable watertight floor outlets. These outlets, of which a number of types are illustrated, are provided with leveling vertical adjustment, and are said to be absolutely watertight. The bulletin includes short descriptions of the outlets and a complete price list.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY, Chicago, Ill., is sending to the trade a mid-season reminder in the form of a small folder. Several different types of flasher of various capacities are illustrated. In connection with these short descriptions are given. The Company announces that it is prepared to make prompt deliveries on special or stock orders.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, O., has purchased the Jandus Electric Company, of Cleveland, O., and will continue the manufacture and sale of the latter company's alternating and direct-current fan motors, arc lamps and lighting specialties. The Adams-Bagnall Company will enlarge its present factory and will shortly begin construction on a new three-story block building.

STANLEY & PATTERSON, New York, N. Y., announce in a recent folder a new feature in the 1911 model of the Minneapolis heat regulator and time attachment. The clock which is illustrated is detachable so that it may be easily removed for winding and setting, and also easily replaced. The heat regulator consists of a thermostat (or mechanical thermometer), a reliable clock mounted in connection with the thermostat motor and two cells of combined circuit batteries.

LOUIS M. PIGNOLET of New York, N. Y., has distributed to the trade a number of folders on the Pignolet instruments. These are made in several types, including the electromagnetic, portable permanent-magnet, and portable d'Arsonval. The instruments are small enough so that they may be easily carried in the pocket, although the scales are long enough for close readings even of such high ranges as 150 volts. The Company also manufactures compact sheet metal switchboard instruments.

THE MINERALLAC ELECTRIC COMANY, Chicago, Ill., recently published a bulletin, superseding Bulletin No. 20, on the Chicago printing attachment for watt-hour meters. The attachment records automatically the quantity of power consumed during any desired interval, printing the result in figures. The device may be attached to any high-grade alternating or direct-current wattmeter. Illustrations of the switchboard attachments and of the portable testing attachment are shown and their operation briefly explained.

JENKINS BROTHERS, New York, N. Y., have presented to their customers and the trade their latest catalog, calling attention to their increased varieties of goods. In addition to the regular line of valves for pressures up to 150 pounds, the Company is now manufacturing valves for extreme pressures to meet the new conditions of increasing pressure. The Company announces that it has maintained its high standard in the manufacture of packing, pump valves, and other rubber specialties, and has made improvements wherever possible.

THE ELMER P. MORRIS COMPANY, 86 West Street, New York, N. Y., has recently issued an artistic bulletin, No. 19, covering street-lighting brackets, in which many attractive designs are illustrated, including its latest specialty, known as the "On the Level" central-suspension fixture. This bulletin is ready for distribution and will be mailed upon request. The new factory at Elizabethtown, Pa., has been in operation for some time and the Company is prepared to deliver promptly the various posts, poles, etc., which it manufactures.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburg, Pa., has issued an instructive pamphlet on the principles of construction and operation of watt-hour meters. Though in the form of a descriptive circular, the pamphlet goes at some length into the question of rates and the theory of meters, and points out the importance of the various features and adjustments of modern meters, for both alternating and direct current. Even to one reasonably familiar with the subject, the pages on "Selection of Watt-hour Meters" will bring out valuable points often lost sight of. The book further describes the latest style of Westinghouse Type C induction watt-hour meters, with micrometer light-load adjustment and permanent magnets so arranged as to be really permanent, both in position and strength. The ball and jewel type of bearing and other features are described and illustrated, also a method of meter testing without the use of a stop watch. The serial number of the publication is Circular 1137.

THE CENTRAL STATION DEVELOPMENT COMPANY, of Cleveland, O., will shortly move its offices from the Schofield Building to a large suite in the Rockefeller Building. W. H. Wissing, vice-president and general manager of the Company will devote his entire time to the affairs of the Central Station Development Company, making his headquarters in Cleveland. This company has also enlarged its facilities and its operations have become so popular that it has been necessary to greatly increase its management and operative organization. Leonard J. Botting has joined the Company as secretary and will have charge of the examination, auditing and appraisal work of the Company. Since 1901 Mr. Botting has been connected with the Constantine Hydraulic Company, of Three Rivers, Mich., serving this company as secretary and general manager, and also acting as United States receiver for several properties. Mr. Botting has been particularly successful as a financial expert in public service matters, and he has always been an ardent advocate of new business methods such as those which have been so successfully worked out by the Central Station Development Company. A lecture bureau has been established by the company under the direction of F. Laurent Godinez. Mr. Godinez has recently completed a transcontinental tour in the interests of the H. L. Doherty Company, and his work has been a gratifying success. Mr. Godinez has a great faculty for taking the terminology of electrical demonstrations and elucidating in good English these somewhat dry technical problems, so that the interest of large audiences is maintained to the end of his address. He has developed a highly instructive and interesting stage setting and his program is replete with good information delivered in the most satisfying manner. This lecture bureau will be of great benefit in the upbuilding of the central station business and Mr. Godinez will add strength to the organization.

DATES AHEAD.

American Physical Society. Next meeting, Chicago, Ill., November 26.

American Association for the Advancement of Science, and affiliated societies. Minneapolis, Minn., December 27-31.

Chicago Electric Show. Coliseum, Chicago, Ill., January 7-21.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 15, 1910.

975,396. VACUUM CLEANING APPARATUS. Frederic B. Cochran, New York. Filed July 8, 1909. A motor-driven device with dust filter, etc.

975,399. STARTING MEANS FOR VAPOR-RECTIFYING DEVICES. Frank Conrad, Swissvale, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Sept. 20, 1906. A vapor-rectifying device for alternating current comprises a receptacle for the vapor, a negative terminal, and an auxiliary

terminal, with means (for causing electrical discharges between the auxiliary and negative terminals) composing inductively related primary and secondary circuits, the latter of which is connected between the negative and auxiliary terminals, a condenser in the secondary circuit, and means for opening the primary circuit after the rectifying process has begun.

975,401. MAGNETO-ELECTRIC MACHINE. Sherman B. Daugherty and Solomon F. Johnson, Indianapolis, Ind. Filed March 21, 1910. A special frame structure is described.

975,404. ELECTRIC LOCOMOTIVE. George M. Eaton, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Filed March 15, 1909. A skeleton frame construction for the motor.

975,417. ELECTRIC-CIRCUIT SWITCH. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed Jan. 10, 1908. The insulating posts for the switch blades are frusto-conical in shape and are provided with holes in which the supports for the switch blade are cemented.

975,418. ELECTRIC SWITCHING DEVICE. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed March 9, 1908. Midway between stationary contact members is an electromagnetically rotated insulator carrying a bridging member.

975,419. ELECTRIC-CIRCUIT SWITCH. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed April 10, 1908. A switch comprises a pair of stationary terminal members, and a substantially horizontal bridging member having a fusible element, and means for detachably suspending the bridging member from the terminal member, one of the means being a link hinge.

975,420. SYSTEM OF ELECTRIC-CIRCUIT PROTECTION. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Jan. 21, 1909. In combination with a high-voltage circuit is a circuit interrupted with a rod or bar for tripping the interrupter, electroresponsive means for raising the rod or bar and means for holding it in its raised position, a high-voltage electomagnet associated with the high-voltage circuit for releasing the holding means and an auxiliary switch operatively connected to the circuit interrupter for opening the circuit of the lifting magnet except when the circuit interrupter is open.

975,421. CIRCUIT-BREAKER. Ford W. Harris, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed July 28, 1909. A fusible cord adapted to resist tensile strains comprises a fuse wire and a strand or strands of combustible fibrous material.

975,422. DISCONNECTING SWITCH FOR HIGH-POTENTIAL CIRCUITS. Stephen Q. Hayles, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Nov. 8, 1909. A disconnecting switch comprises a stationary contact member, a lever pivotally supported above the member, a co-operating movable contact terminal freely suspended from comprising a series of insulators one above another, connected the outer end of the lever and an interposed insulating structure comprising a series of insulators one above another, connected by link connections.

975,424. BRUSH-HOLDER. William T. Hensley, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed Nov. 8, 1907. A brush-holder for dynamo-electric machines comprises a supporting rod or shaft, a clamping ring secured to the shaft and having a notched outer surface, an arm rotatably mounted on the rod or shaft, and a double spiral spring, interposed between the arm and the rod.

975,425. FIELD-WINDING COIL FOR DYNAMO-ELECTRIC MACHINES. William T. Hensley, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed March 9, 1908. A wedge-shaped coil for electric apparatus has a plurality of single-layer turns of conducting material of varying widths and uniform cross-sectional area from one coil end to the other.

975,427. KEYBOARD APPARATUS FOR PUNCHING TELEGRAPHIC TRANSMITTING-TAPES. Romyn Hitchcock, New York. Filed Aug. 2, 1906. Serial No. 328,829. Renewed April 12, 1910. A telegraph tape-punching apparatus is described in detail.

975,431. ELECTRIC-CIRCUIT INTERRUPTER. Ray P. Jackson, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, a. Filed Jan. 10, 1908. It comprises stationary contact members, a switch arm pivotally mounted on one of the members and comprising an insulating tube and a fusible conductor contained therein, and means dependent upon the rupture of the fusible conductor for automatically separating one end of the tube from its engaging contact member.

975,436. VIBRATORY MASSAGE APPARATUS. Fred R. Kunkel, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Feb. 2, 1907. A circuit interrupter hand apparatus containing its own motor.

975,437. VIBRATORY MASSAGE APPARATUS. Fred R. Kunkel, Edgewood Park, Pa., assignor, by mesne assignments, to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed Jan. 10, 1908. Similar to the preceding.

975,476. ARMATURE-WINDING FOR DYNAMO-ELECTRIC MACHINES. Norman W. Storer, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Jan. 3, 1906. Reversely bent relatively high-resistance conductors are located in the core slots beneath the winding, and conductors of lower resistance and less width than the conductors are connected to the opposite ends thereof and respectively to the armature winding and the commutator cylinder segments and arranged in two concentric rows.

975,477. ARMATURE-WINDING FOR DYNAMO-ELECTRIC MACHINES. Norman W. Storer, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Jan. 3, 1906. The winding comprises groups of coils, and resistance conductors for connecting the winding to the commutator cylinder segments, strips of good heat-conducting material being placed between adjacent resistance conductors and electrically insulated therefrom.

975,478. ARMATURE-WINDING FOR DYNAMO-ELECTRIC MACHINES. Norman W. Storer, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. Filed March 2, 1908. A resistance conductor has portions of reduced section and coatings of relatively high conductivity to increase the current-carrying capacity of the portions.

975,481. TELEGRAPH-POLE OR FENCE-POST MOLD. Frederick H. Tirnam, Oklahoma, Okla. Filed Sept. 4, 1909. A form section for concrete poles.

975,504. TELEPHONE SYSTEM. Clifford C. Bradbury, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill. Filed October 16, 1907. A cord circuit is adapted to connect lines for conversation. Answering and calling supervisory signals are provided for the cord circuit, the circuit of these signals being completed over a path independent of the talking circuit and including contacts of the answering plug and jack when the answering plug is connected with the answering jack. The circuit of one of the signals is also under the control of the calling subscriber, and the circuit of the other signal is also under the control of the answering subscriber.

975,512. IGNITION MEANS FOR INTERNAL-COMBUSTION ENGINES. Mark B. Crist, Pittsburg, Pa., assignor to The Westinghouse Machine Company. Filed February 15, 1906. A spark-plug mounting disk is provided with a number of openings adapted to receive spark plugs, and means for locking the disk in different positions carry a terminal support for the igniter plugs.

975,529. SWITCH. William Kaisling, Chicago, Ill., assignor, by mesne assignments, to Kellogg Switchboard & Supply Company. Filed February 6, 1909. A telephone switch comprises an arcuate bank of fixed contacts, rotating wipers individually engageable during rotation with different ones of the contacts, and electromagnetically actuated step-by-step mechanism for individually rotating the wipers.

975,530. SWITCH. William Kaisling, Chicago, Ill., assignor, by mesne assignments, to Kellogg Switchboard & Supply Company. Filed February, 1909. An automatic telephone switch.

975,532. MOTOR SUCTION-PUMP. William H. Keller, Philadelphia, Pa., assignor to Keller Manufacturing Company, Philadelphia, Pa. Filed February 17, 1909. A motor suction-pump comprises a casing, a partition located intermediate the ends of the casing, a pump chamber on one side of the partition, a rotary piston mounted in the chamber and having means for engaging the walls of the chamber for positively forcing air through the pump, and a motor located within the casing on the other side of the partition. The motor includes a field frame separated from the casing so as to provide a passage for the exhaust air from the pump.

975,533. STORE-SERVICE CREDIT-SYSTEM APPARATUS. Charles F. Kettering, Dayton, Ohio, assignor to the National Cash Register Company, Dayton, Ohio. Filed December 14, 1904. A telephone system.

975,534. METHOD AND APPARATUS FOR WRECKING BODIES SUNK IN WATER. Robert Owen King, Buffalo, N. Y. Filed February 18, 1909. An apparatus for wrecking bodies sunk in water comprises a support, an electromagnet pivoted on the support and adapted to attach itself to the body, and a drilling device mounted on the support.

975,569. MULTIPLE FUSIBLE CUT-OUT FOR ELECTRICAL CIRCUITS. Albert Edward Partington, Sydney, New South Wales, Australia. Filed May 6, 1910. The cut-out includes a revoluble barrel for nonconducting material, fuses removably contained therein and having metallic contacts protruding beyond the barrel ends, supporting means removably holding the barrel, spring contacts held by the supporting means engaging the metallic contacts.

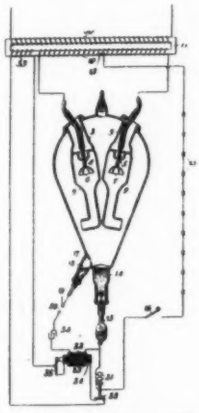
975,571. ELECTRIC FURNACE WITH MAGNETICALLY-ROTATED CHARGE. Henry Noel Potter, New Rochelle, N. Y., assignor to Geo. Westinghouse, Pittsburg, Pa. Original application filed July 25, 1904. Divided and this application filed July 1, 1905. The method of stirring highly heated, fused, conducting material, consists in maintaining an alternating rotating magnetic field in inducing relation thereto.

975,572. SYSTEM OF MOTOR CONTROL. Frank B. Rae, Boston, Mass. Filed February 18, 1910. A control system for series motors.

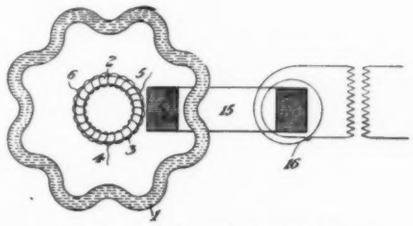
975,585. ELECTRIC-CIRCUIT CONTROLLER FOR RAILWAY SWITCHES. Guy M. Thompson, Seattle, Wash., assignor to the G. M. Thompson Railway Switch Company, Seattle, Wash. Filed May 18, 1909. A trolley-actuated circuit controller.

975,592. ELECTRIC-CABLE JOINT. Wilbur O. Wilson, Chicago, Ill. Filed August 16, 1909. The insulation is affected by paper sleeves and paraffin filling.

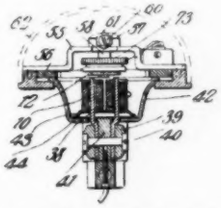
975,608. SWITCH FOR AUTOMATIC TELEPHONE SYSTEMS. Alfred H. Dyson, Chicago, Ill., assignor, by mesne assignments, to Kellogg Switchboard & Supply Company. Original application filed October 31, 1905. Divided and this application filed July 5, 1907. There are passive contacts arranged in rows, movable arms having contact ends adapted to engage the contacts, a primary shaft and a magnet therefor for rotating the ends in one plane to select a row, a secondary shaft and a magnet therefor for rotating the ends in a selected intersecting plane to select a contact of a row, and an off-normal switch actuated on the first movement of the primary shaft and a second off-normal switch actuated on the first movement of the secondary shaft.



975,399.—STARTER FOR MERCURY-VAPOR RECTIFIER.



975,794.—ELECTRIC FURNACE.



975,933.—TELEPHONE REPEATER.

975,650. LATERAL TROLLEY FOR ELECTRIC RAILWAYS. Albert J. Steinweg, Chicago, Ill. Filed April 1, 1907. A third-rail system.

975,669. LAMP-REFLECTOR. Henry Zirwas, Yonkers, N. Y. Filed January 3, 1910. A lamp reflector has integral with itself at its upper end a screw thread, an outer socket shell having a lower thread engaged by the reflector thread, and an insulated portion, firmly carried by the reflector thread.

975,712. ELECTRIC HEATER. Leon F. Parkhurst and Harry G. Weeks, Binghamton, N. Y., assignors to Diamond Electric Company, Binghamton, N. Y. Filed September 27, 1909. A portable electric radiator.

975,756. MULTIPLEX-TELEGRAPH APPARATUS. Stephen Dudley Field, Stockbridge, Mass. Filed March 25, 1910. There are means for rendering the receiving instruments irresponsive to outgoing signals, a self-adjusting transmitter in each transmitter branch, a pair of identical self-adjusting transmitters at each station and means for operating each pair of transmitters simultaneously.

597,757. CONDUIT-HOOD. Louis A. Flenry, Jr., Indianapolis, Ind., assignor to one-fourth to Henry C. Dippel, Indianapolis, Ind. Filed October 8, 1909. A conduit-hood comprises a closure, and means for attaching the same to a conduit, all stamped from one piece of metal.

975,777. ATTACHMENTS FOR ELECTRICAL CONDUITS. Adnah McMurtrie, New York, N. Y., assignor to Thomas & Betts Company, New York, N. Y. Filed April 25, 1907. An attaching member comprises a wedge to enter a sheath-receiving aperture in an outlet box between the sheath and the wall of the aperture, and means to drive the wedge through the wall co-axially with respect to the sheath, to force the sheath into direct physical and electrical contact with the opposite wall of the aperture.

975,794. ELECTRIC FURNACE WITH MAGNETICALLY ROTATED CHARGE. Henry Noel Potter, New Rochelle, N. Y., assignor to George Westinghouse, Pittsburg, Pa. Filed July 25, 1904. An alternating induction stator has a space within which molten metal adapted to serve as a rotor therefor may be located.

975,823. LIGHTING-FIXTURE. George D. Beinert, New York, N. Y. Filed Dec. 19, 1908. Lamp brackets for work tables.

975,835. PROCESS OF ELECTROLYTICALLY TREATING TANNIC INFUSIONS, OF PLANTS. Hermann Damköhler and Hugo Schwindt, Bremen, Germany. Filed June 16, 1909. The process of treating tanic infusions of plants, such for example as the bark of the mangrove, consists in subjecting the infusions to the electrolysis within a cell, in which the tannic infusion forms a bath for the cathode which is separated from the anode by a porous partition wall, and in which the baths for the electrodes contain solutions of metal salts the metals of which are those of the electrodes.

975,842. MAGNETO-INTERRUPTER. Willard E. Dow, Braintree, Mass. Filed June 16, 1908. The magneto includes a rotary part, a current interrupter, having its terminals rotated by said part, and means for adjusting the terminals toward and from each other while they are being rotated.

975,845. WELDING METALLIC FILAMENTS TO LEAD-WIRES. Karl Farkas, New York, N. Y., assignor of one-half to Guy V. Williams, New York, N. Y. Filed October 4, 1909. An appliance for welding electric conductors to metallic filaments, comprises a supporting member for the filament-carrying steam, an electrode operatively connected to the supporting member, and a second electrode for forming the small fusing arc.

975,875. ELECTRIC PLUG AND SOCKET. Louis W. Kutsch, Chicago, Ill. Filed February 10, 1910. The plug consists of a forked wooden handle, a porcelain insulating member between the forks and electric terminals secured to the porcelain, the whole so arranged that the forks protect the porcelain against injury in case of fall.

975,879. DEVICE FOR TESTING ELECTRICAL APPARATUS. Harry B. Lehman, Columbus, Ohio. Filed June 6, 1910. The device comprises a suitable support, two angle arms, an insulated block interposed between the angle arms and having a transverse bore therein, and sparking pins extending into the insulated block and having their terminals spaced apart in the opening within the block.

975,885. ALKALINE BATTERY CONTAINING CHROMIUM AND MERCURY. William Morrison, Des Moines, Iowa. Filed November 22, 1909. A reversible alkaline battery comprises an anode, or negative-pole electrode, containing zinc and a chromium-oxygen compound.

975,909. THERMOSTAT. Richard Hyde Waite, Denver, Colo. Filed June 16, 1909. Controls an electric circuit.

975,918. LOCK FOR SWITCHES. Gottlieb Wuelser, New Kensington, Pa. Filed July 26, 1910. Includes rotatable locking disks.

975,919. MOTOR-MOUNTING FOR WASHING-MACHINES. Isidor Yassenoff, Columbus, Ohio, assignor to the Swash Motor Washer Company, Columbus, Ohio. Filed May 24, 1909. A cover is constructed to overlie the upper edge of the tub and abut against the inner face thereof; a swivel connection between the cover and one side of the tub permits the cover to swing both vertically and horizontally; fasting means secure the cover in normal position to another side of the tub; and a motor is mounted on the cover.

975,922. SWITCH-SIGNAL. Thomas Wilburt Adams, Collinwood, Ohio, assignor of one-third to George W. Albaugh, Cleveland, Ohio. Filed March 2, 1910. Electric signal for railway switch.

975,933. TELEPHONE-REPEATER. Samuel L. Campbell, Prairie City, Ore. Filed October 29, 1908. Renewed March 3, 1910. A telephone repeater system comprises a local microphone circuit at one station, a line circuit in inductive relation to the microphone circuit, a repeater unit at a distant point in the circuit comprising receiver coils and a magnet, an inclosing cup carried thereby, a flanged ring receiving and engaged by the cup, a bridge piece on the ring and clamping the cup to the ring, a microphonic element carried by the bridge piece, a free armature carried by the microphonic element in operative relation

to the free ends of the receiver magnet pole-pieces, a circuit controlled by the last-named microphonic element, and a circuit in inductive relation to the last-named circuit and containing a receiver.

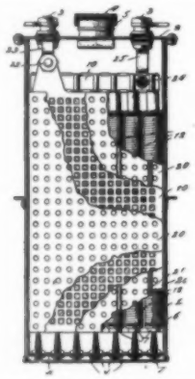
975,935. ARC-LAMP. Tito Livio Carbone, Charlottenburg, Germany. Filed March 19, 1909. An arc-lamp globe specially adapted to the use of impregnated carbons is divided into a plurality of superposed chambers by suitable configuration of the walls, the middle chamber having a transparent wall surrounding the arc closely for preventing the gases produced by the arc from condensing on the walls.

975,936. COMBINED ELECTRIC IRON AND STOVE. Burton R. Charles, Portland, Ore. Filed February 25, 1910. The iron can be inverted and supported on the handle when it is desired to use it as a stove.

975,980. ALKALINE BATTERY. William Morrison, Des Moines, Iowa. Filed December 3, 1909. The process of making a positive-pole electrode for reversible alkaline batteries, consists in producing an intimate mixture of finely-divided compounds of silver and mercury, applying the mixture to a conductor or support, and electrolytically reducing the compounds to silver and mercury.

975,981. ELECTRODE FOR REVERSIBLE GALVANIC BATTERIES. William Morrison, Des Moines, Iowa. Filed October 10, 1910. An electrode for reversible galvanic batteries, in which an alkaline electrolyte is used, consists of one or more tubes or porous material, each of the tubes consisting of a series of cells within which the active material is held.

976,002. PRODUCTION OF LONG STABLE ELECTRIC ARCS. Otto Schönherr and Johannes Hessberger, Ludwigshafen-on-the-Rhine, Germany, assignors to Radische Anilin & Soda Fabrik, Ludwigshafen-on-the-Rhine, Germany. Filed January 10, 1907. The process of producing long stable electric arcs in tubes or passages provided with insulated electrodes consists in passing



976,092.—REVERSIBLE GALVANIC BATTERY.

currents of gas through the tubes or passages and causing a plurality of arcs to terminate in a common space.

976,037. PROCESS OF TREATING VEGETABLE MATTER. George D. Burton, Boston, Mass. Filed October 22, 1906. Renewed April 1, 1910. The process of treating vegetable matter consists in subjecting it to the action of a saponaceous solution containing an electrolytic chemical acid; then subjecting the solution and the matter contained therein to the action of an electric current; then subjecting the matter to the action of an oily solution; then again subjecting it to the action of a saponaceous solution; and then immersing the matter in a solution consisting of water and spirits.

976,050. COMBINED TELEGRAPH AND TELEPHONE SYSTEM. Edward H. Cunningham, Des Moines, Iowa. Filed August 17, 1907. In combination with a metallic telephone circuit, are a high-tension line wire, an impedance connecting together the two sides of the telephone circuit, a lead connecting the electrical center of the impedance with the ground, telegraphic receiving devices in the lead, a connection between the line wire and this lead above the receiving devices, and a sending key in the connection.

976,092. REVERSIBLE GALVANIC BATTERY. William Morrison, Des Moines, Iowa. Filed October 10, 1910. A reversible galvanic battery comprises a negative-pole electrode containing zinc and a chromium-oxygen compound, a positive-pole electrode containing silver and mercury, and an alkaline electrolyte.

976,100. TERMINAL-FASTENING. Albert Schmidt, Flint, Mich., assignor to Champion Ignition Company, Flint, Mich. Filed February 7, 1910. In combination with a terminal stem having a groove, is an eye to receive the stem adapted to be attached to an electrical conductor, and a spring secured to the eye and normally projecting into the opening thereof to engage the groove in the stem.

976,101. SPARK-PLUG. Albert Schmidt, Flint, Mich., assignor to Champion Ignition Company, Flint, Mich. Filed June 9, 1910. Comprises a bushing having a chamber, an insulating plug having an annular bead within the chamber, a supporting ring having flanges embracing the bead and a horizontally extending portion to support the plug, and means for detachably securing the horizontal portion to the bushing and forcing the flanges into engagement with the bead.

976,123. SELECTIVE RINGING MEANS FOR TELEPHONE SYSTEMS. Edward E. Clement, Washington, D. C., assignor to the North Electric Company, Cleveland, Ohio. Filed January 18, 1907. A trunk ringing system for telephone exchanges comprises means controlled by an A operator for connecting a calling subscriber with a trunk line, means at a B or trunking station for connecting the trunk with the wanted subscriber's line (the line serving more than one subscriber's station), a selective signalling device at each station, a plurality of generating devices associated with the B switching position, and automatic means controlled through the trunk line by the A operator for selecting and connecting the proper generator to ring the bell at the desired station.

976,130. ALTERNATING-CURRENT CONTROLLING APPARATUS FOR HYDRAULIC ELEVATORS. David L. Lindquist, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed June 1, 1907. A double multiphase alternating-current electromagnet has two sets of windings for actuating the valve apparatus; a phase-splitting device changes single-phase to multiphase current; and a system of circuits and switches selects one of the two sets of windings of the multiphase magnet for receiving multiphase current to effect the operation of the valve apparatus.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired November 21, 1910:

508,926. CASING FOR ELECTRIC-ARC LAMPS. Peter Federmann, Berlin, Germany.

508,946. AUTOMATIC RAILWAY ELECTRIC SIGNAL. Burton A. Karr and Charles H. Bradrick, Omaha, Neb.

509,002. ELECTRIC RAILWAY. Jonathan H. Vail, New York, N. Y.

509,014. ELECTRIC-ARC LAMP. Henry P. Bakl, Brooklyn, N. Y.

509,036. AUTOMATIC THERMAL CUT-OUT FOR INCANDESCENT ELECTRIC LAMPS. Edward H. Johnson, New York, N. Y.

509,050. ELECTRIC BELL. William J. Schweuger, New York, N. Y.

509,061. SPEAKING ATTACHMENT FOR TELEPHONES. William Weber and George Weber, Philadelphia, Pa.

509,065. ELECTRIC-RAILWAY CONDUIT. Granville T. Woods, New York, N. Y.

509,066. TELEGRAPHY. Julien P. Wooten, Bainbridge, Ga.

509,072. ELECTRIC RAILWAY. John H. Dale, New York, N. Y.

509,075. BASE FOR STEREOTYPE OR ELECTROTYPE PLATES. Herman Fietsch, Jr., Chicago, Ill.

509,085. ELECTRIC CIGAR-LIGHTER. Christian J. Jenne and Charles E. Willey, Louisville, Ky.

509,091. MAGAZINE GUN AND ELECTRICAL DEVICES THEREFOR. John L. McCullough, Brooklyn, N. Y.

509,093. ELECTRO-MECHANICAL SLOT MECHANISM FOR RAILWAY SIGNALS. Thomas H. Patenall, Rahway, N. J.

509,095. ELECTRIC METER. John Perry, London, England.

509,116. ELECTRICALLY-CONTROLLED DOOR. Frank Callahan, Bridgeport, Conn.

509,167 and 509,168. ELECTRIC-ARC LAMP. Rudolph M. Hunter, Philadelphia, Pa.

509,171. ELECTRIC-SIGNAL RECEIVER. William H. Kirnan, Bayonne, N. J.

509,186. TELEPHONE-EXCHANGE APPARATUS. Charles E. Scribner, Chicago, Ill.

509,216. FIRE ALARM TELEGRAPH REPEATER. Thomas F. Gaynor, Louisville, Ky.

509,217. COMBINED ELECTRIC TIME-STAMP AND SIGNAL DEVICE. Thomas F. Gaynor, Louisville, Ky.

509,218. ELECTRIC SIGNAL DEVICE. Thomas F. Gaynor, Louisville, Ky.

509,219. NON-INTERFERENCE SIGNAL BOX MECHANISM FOR FIRE-ALARM TELEGRAPHS. Thomas F. Gaynor, Louisville, Ky.

509,244. ELECTRICAL APPARATUS FOR CONTROLLING SIGNAL OR OTHER CIRCUITS. Homer A. Parrish, Jackson, Mich.

509,266, 509,267, 509,268, 509,269, 509,270, 509,271 and 509,272. STORAGE BATTERY. Edward P. Usher, Grafton, Mass.

509,279. REGULATING SWITCH FOR ELECTRIC ELEVATORS. Henry A. Allen, Chicago, Ill.

509,290. SIGNAL TELEGRAPH. Claudius V. Boughton, Buffalo, N. Y.

509,312. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. John C. Henry, New York, N. Y.

509,322. CURRENT-CONTROLLING DEVICE. William H. Morgan, Alliance, O.